June 15, 2001

MEMORANDUM

SUBJECT: **REVISED** OCCUPATIONAL EXPOSURE ASSESSMENT FOR THE REREGISTRATION ELIGIBILITY DECISION DOCUMENT FOR DISULFOTON

FROM: Richard Griffin
Reregistration Branch 2
Health Effects Division (7509C)

TO: Christina Scheltema
Reregistration Branch 3
Special Review and Reregistration Division (7508W)

THRU: Al Nielsen, Branch Senior Scientist
Reregistration Branch 2
Health Effects Division (7509C)

Please find attached the revised occupational exposure and risk assessment for disulfoton. **Please note that there are unresolved data compensation issues related to the Agency's use of proprietary data to assess the risks for handler scenarios involving loading/applying granular formulations with a pump- or gravity-feed backpack spreader.**

The following changes necessitated this revised occupational exposure and risk assessment for disulfoton:

1) The registrant notified the Agency that it would not support several crops and use-patterns that were included in the original risk assessment;
2) The registrant notified the Agency that it was reducing the maximum supported application rate for several crops;
3) The REVISED (3nd) Report of the Hazard Identification Assessment Review Committee for disulfoton issued January 18, 2001 established the short-term dermal NOAEL for use in occupational and residential risks assessments at 0.5 mg/kg/day based on a newly submitted 3-day dermal rat study – the previous short-term dermal NOAEL for such

assessments was 0.4 mg/kg/day;

4) The Health Effects Division on August 7, 2000 adopted revised Policy 3.1 from the Science Advisory Council for Exposure that presents interim transfer coefficients (TC) for agricultural or commercial activities for use in post application exposure assessments;
5) The Health Effects Division on June 23, 2000 adopted revised Policy 9 from the Science Advisory Council for Exposure that provides standard values for the number of acres that can be treated in a single day by various types of agricultural equipment;
6) Newly available and better quality ORETF data for the push-type granular spreader equipment is used in place of the PHED data set for this scenario;
7) Additional exposure scenarios were added because proprietary data became available to assess applying granular formulation with backpack equipment;
8) Newly available proprietary data were used to assess the exposure from the occupational scenario for applying granular with a bucket and spoon – previously PHED data for applying granular bait by hand was used as a surrogate for this scenario;

DP Barcode: D275169

Pesticide Chemical Codes: 032501

EPA Reg Nos.: 4-153, 4-253, 4-420, 16-171, 70-236, 192-74, 192-119, 192-126, 192-164, 239-2134, 572-346, 769-908, 802-426, 869-76, 869-223, 904-138, 3125-83, 3125-116, 3125-152, 3125-172, 3125-307, 3125-517, 5887-67, 5887-171, 7401-4, 4701-26, 7401-235, 7401-323, 9404-3, 8660-125, 8660-191, 11474-17, 32802-32, 34704-475, 42057-51, 46260-2, 46260-12, 46260-35, 59144-23; SLNs for 3125-172: -WA-850036; -ID-850016; -MT-800004; -OR-8000034; -NM-880001; NC-880001; -NC-920011; -WA-980004; SLNs for 3125-307: -CA-840192; -WA840036; -CA-760019; -CA-770036; -CA-770036; -CA-810044; -TX-900004; -OR-910027; -TX-860007; -WA-920026;

PHED: Yes, Version 1.1

EXPOSURE AND RISK ASSESSMENT/CHARACTERIZATION

Purpose

In this document, which is for use in EPA's development of the Disulfoton Reregistration Eligibility Decision Document (RED), EPA presents the results of its review of the potential human health effects of occupational exposure to disulfoton. This memorandum revises the occupational exposure section of the February 7, 2000 memorandum titled "Revised Occupational and Residential Exposure Assessment and Recommendations for the Reregistration Eligibility Decision Document for Disulfoton" and the August 24, 2000 memorandum titled "Amendment to the the Disulfoton Occupational and Residential Exposure and Risk Assessment." [1,2]

Criteria for Conducting Exposure Assessments

An occupational exposure assessment is required for an active ingredient if (1) certain toxicological criteria are triggered and (2) there is potential exposure to handlers (mixers, loaders, applicators, etc.) during use or to persons entering treated sites after application is complete. For disulfoton, both criteria are met.

Summary of Toxicity Concerns Relating to Occupational Exposure

Acute Toxicology Categories

Table 1 below presents the acute toxicity categories based on the active ingredient as outlined in the Hazard Identification document.[3]

Table 1: Acute Toxicity Categories for Disulfoton

Guideline No.	Study Type	MRID #.	Results	Toxicity Category
81-1	Acute Oral	Acc# 072293	LD_{50} = M: 6.2 mg/kg; F:1.9 mg/kg	I
81-2	Acute Dermal	Acc# 07793	LD_{50} = M: 15.9 mg/kg; F: 3.6 mg/kg	I
81-3	Acute Inhalation	Acc# 258569	LC_{50} = M: 0.06 mg/L; F: 0.89 mg/L	I
81-4	Primary Eye Irritation	None	Data requirement waived.	N/A
81-5	Primary Skin Irritation	None	Data requirement waived.	N/A
81-6	Dermal Sensitization	None	Data requirement waived.	N/A
81-7	Acute Delayed Neurotoxicity	00129384	Equivocal.	NA
81-8	Acute Neurotoxicity	42755801	Reversible neurotoxic signs consistent with the cholinesterase inhibition 1.5 mg/kg in females and 5.0 mg/kg in males.	N/A

Occupational and Residential Endpoints of Concern

The revised Hazard Identification document for disulfoton, indicates that there are toxicological endpoints of concern for occupational exposure. The endpoints used in assessing the risks for disulfoton are presented in the following Table 2.[3]

Table 2: Endpoints for Assessing Occupational Risks for Disulfoton

Test	Results
Short-term Dermal Exposure (1 to 7 days)	0.5 mg/kg/day based on a 3-day dermal study in rats (Target MOE = 100)
Intermediate-term Dermal Exposure (1 week to several months)	0.03 mg/kg/day based on a special 6-month cholinesterase inhibition feeding study (Target MOE = 100)
Inhalation Exposure (All-time periods)	0.00016 mg/L or 0.045 mg/kg/day based on a 90-day inhalation study in rats (Target MOE = 100)
Dermal Absorption (intermediate-term dermal endpoint only)	36%
Inhalation Absorption	100%

SUMMARY OF USE PATTERN AND FORMULATIONS

Type of pesticide/target pests

Disulfoton, (O,O-Diethyl S-[2-(ethylthio)ethyl] phosphorodithioate) is a selective systemic organophosphate insecticide used to control a variety of sucking insects. Examples of the type of insects that disulfoton controls include, but are not limited to, the following:[4]

- vegetables and field crops: aphids, leafhoppers, Mexican bean beetle larvae, mites, thrips and potato psyllid, grasshoppers, flea beetles, southern potato wireworms, root aphids, green peach aphids, Colorado potato beetles, hessian fly; and

- ornamental shrubs, trees and rose bushes: aphids, birch leaf miner, elm leaf beetle, European elm scale, lace bug, leafhoppers, mites, thrips, whiteflies, birch leafminers, camellia scale, holly leafminer, leafhoppers, mimosa webworm, pine tip moth, soft scale, spider mites, tea scale, thrips and whiteflies.

Formulation types and percent active ingredient for occupational products

Disulfoton is formulated as a technical product (98.5 percent active ingredient). It is formulated for occupational use as an emulsifiable concentrate (85, 23, and 17.5 percent active ingredient), and as a granular (15, 10, 6.5, 2, 1, 0.625, 0.5, and 0.37 percent). It is often formulated in combination with fertilizers.[4]

Registered use sites for occupational products[4,5]

- **Agricultural Crops (food and feed crops)**, including peppers, broccoli, Brussels sprouts, cabbage, Chinese cabbage, cauliflower, clover grown for seed (SLN only), lettuce, asparagus (SLN only), radishes grown for seed (SLN only), barley, wheat, cotton, peanuts (SLN only), peas, sorghum, soybeans, white/Irish potatoes, dried, lima, and snap beans, lentils, and tobacco;

  In the original assessment, the following crops were included, however, they are no longer being supported by Bayer and other registrants and have been dropped from this revised assessment: spinach, black and red raspberries, tomatoes, field corn, oats, triticale, sweet corn, sugar beets, popcorn, and strawberries (propagating plants only)

- **Nut Trees and Non-Bearing Fruit Trees:** coffee trees;

  In the original assessment, the following crops were included, however, they are no longer being supported by Bayer and other registrants and have been dropped from this revised assessment: pecan trees and nonbearing apple, crabapple, pear, apricot, cherry, peach, plum and prune trees.

- **Forest Trees:** poplars grown for pulp (SLN only);

- **Ornamental Flowers/Groundcover,** including annuals and bulbs;

- **Ornamental Shrubs and Trees,** including Christmas trees; and

- **Potted Plants:** outdoor only

  In the original assessment, indoor (i.e., greenhouse) potted plants were included, however greenhouse uses are no longer being supported by Bayer and other registrants and have been dropped from this revised assessment.

.

Occupational Application Rates[4,5]

- Emulsifiable Concentrate formulations:

4.0 lb/A	tobacco (Reg #3125-307)
3.0 lb/A	potatoes: foliar OR, WA, ID UT (Reg #3125-307); potatoes: soil (Reg #3125-307); poplars grown for pulpwood (Reg #3125-307--OR-910027)
2.5 lb/A	peas and lentils (Reg #3125-307)

2.0 lb/A	beans: dry, snap, lima (Reg #3125-307); cabbage (Reg #3125-307); lettuce (Reg #3125-307); peppers (Reg #3125-307); radish grown for seed (Reg #3125-307-WA-920026);
1.0 lb/A	asparagus (Reg #3125-307-CA-840192); barley (Reg #3125-307); broccoli (Reg #3125-307); Brussels sprouts (Reg #3125-307); cauliflower (Reg #3125-307); cotton (Reg #3125-307); sorghum (Reg #3125-307); wheat (Reg #3125-307);
0.75 lb/A	wheat (Reg #3125-307)
0.5 lb/A	sorghum (Reg #3125-307); potatoes: foliar (Reg #3125-307)
0.2 lb/A	cotton (Reg #3125-307- TX-860007)

- Granular formulations:

109 lb/A	field-grown ornamental shrubs (Reg #3125-172) based on the assumption that the shrubs are two feet tall and occupy two square feet (i.e., roses);
78 lb/A	Christmas trees (Reg #3125-172) based on the assumption that the trunk is 2 inches in diameter and trees are planted at 1700 per acre;
37 lb/A	field-grown ornamental trees (Reg #3125-172) based on the assumption that the trunk is 2 inches in diameters and trees are planted at 800 per acre;
29 lb/A	field-grown flowers and groundcover (Reg #3125-172)
11 lb/A	field-grown ornamental trees and shrubs: injection (Reg #3125-172) and lower rate for noninjection (Reg #3125-172)
8.3 lb/A	coffee trees (Reg #3125-172) based on the assumption that the trees are 8 feet tall and are planted 435 trees per acre
4.5 lb/A	Christmas trees ((Reg #3125-172-NC-880001)
4.0 lb/A	tobacco (Reg #3125-172);
3.0 lb/A	potatoes: soil (Reg #3125-172);
2.5 lb/A	peas and lentils (Reg #3125-172);
2.0 lb/A	peanuts (Reg #3125-172-NC-920011); peppers (Reg #3125-172); radish grown for seed (Reg #3125-172-WA-920027);
1.5 lb/A	cabbage (Reg #3125-172);
1.0 lb/A	barley (Reg #3125-172); beans: dry, snap, lima: (Reg #3125-172); broccoli (Reg #3125-172); Brussels sprouts (Reg #3125-172); cauliflower (Reg #3125-172); clover grown for seed (Reg #3125-172-WA-980004); cotton (Reg #3125-172); peanuts (Reg #3125-172); sorghum (Reg #3125-172); soybeans (Reg #3125-172); wheat (Reg #3125-172);
0.2 lb/day	potted ornamentals (Reg #3125-172); based on the assumption that 350 pots that are 12 inches in diameter are treated each day.

Application Methods, Types of Equipment Used, and Size of Area Treated[4,5]

EPA estimates the area treated per day based on the type of equipment used on a specific crop. Acres treated per day values are based on HED Exposure SAC Policy # 009 “Standard

Values for Daily Acres Treated in Agriculture," revised June 23, 2000, or best professional judgment when data is not available.

- For aerial equipment (mix/load, apply) the daily acres treated is 1200 acres per day for barley, cotton (SLN), sorghum, and wheat; flagging for such crops is given as 350 and 1200 acres per day; for aerial equipment (mix/load, apply, and flag) for all other crops is 350 acres per day;

- For chemigation equipment the daily acres treated is 350 acres for broccoli, Brussels sprouts, cabbage, cauliflower, cotton, lettuce, poplars grown for pulp, and potatoes;

- For groundboom spray equipment (mix/load and apply) the daily acres treated is 200 acres per day for barley, cotton, sorghum, and wheat; groundboom spray equipment for all other crops is 80 acres per day;

- For tractor-drawn granular equipment (load and apply) the daily acres treated is 200 acres per day for barley, cotton, sorghum, soybeans, and wheat; tractor-drawn granular equipment for coffee and all ornamental crops is 40 acres per day; the assumption for other crops is 80 acres per day;

- For push-type granular equipment (load/apply) the daily acres treated is 5 acres per day for ornamental shrubs, trees, Christmas trees, flowers, and groundcover;

- For bellygrinder granular equipment (load/apply) the daily acres treated is 5 acres per day for ornamental shrubs, trees, Christmas trees, flowers, and groundcover;

- For pump-feed and gravity feed backpack granular spreaders and scoop/bucket techniques (load/apply), the daily acres treated ranges from 5 to 10 acres per day for ornamental shrubs, trees, Christmas trees, coffee trees, flowers, and groundcover; for applying to individual potted plants, the amount treated is 350 pots per day.

OCCUPATIONAL RISK ASSESSMENT AND CHARACTERIZATION

Occupational Handler Exposures Scenarios

HED has determined that occupational handlers are likely to be exposed during disulfoton use. The anticipated use patterns and current labeling indicate several major exposure scenarios based on the types of equipment that potentially can be used to make disulfoton applications. These scenarios include: (1a) mixing, loading liquid formulations (emulsifiable concentrates) for aerial application; (1b) mixing, loading liquid formulations (emulsifiable concentrates) for chemigation application; (1c) mixing, loading liquid formulations (emulsifiable concentrates) for groundboom application; (2a) loading granulars for aerial application; (2b) loading granulars for tractor-drawn spreader application; (3) applying sprays with aircraft; (4) applying granulars with aircraft; (5) applying sprays with a groundboom; (6) applying granulars

with a tractor-drawn spreader; (7) loading and applying granulars with a push-type granular spreader;(8) loading and applying granulars using a belly grinder; (9a) loading and applying granulars with a pump-feed backpack spreader; (9b) loading and applying granulars with a gravity-feed backpack spreader; (10) loading and applying granulars with a scoop and bucket; (11) flagging during aerial spray applications; and (12) flagging during aerial granular applications. Loading and applying granulars with a motorcycle or all-terrain vehicle equipped with a spreader is another known application method for ornamentals, including Christmas trees, however no data are available to assess this scenario.

Handler Exposure Data - Surrogate

Pesticide Handler Exposure Database (PHED)

The PHED Task Force is comprised of representatives from the U.S. EPA, Health Canada, the California Department of Pesticide regulation, and member companies of the American Crop Protection Association. PHED is a software system consisting of two parts: a database of measured exposure values for workers involved in the handling of pesticides under actual field conditions and a set of computer algorithms used to subset and statistically summarize the selected data. Currently, the database contains values for over 1,700 monitored individuals (i.e., replicates).

Users select criteria to subset the PHED database to reflect the exposure scenario being evaluated. The subsetting algorithms in PHED are based on the central assumption that the magnitude of handler exposures to pesticides are primarily a function of activity (e.g., mixing/loading, applying), formulation type (e.g., wettable powders, granulars), application method (e.g., aerial, groundboom), and clothing scenarios (e.g., gloves, double layer clothing).

Once the data for a given exposure scenario have been selected, the data are normalized (i.e., divided by) by the amount of pesticide handled resulting in standard unit exposures (milligrams of exposure per pound of active ingredient handled). Following normalization, the data are statistically summarized. The distribution of exposure values for each body part (e.g., chest upper arm) is categorized as normal, lognormal, or "other" (i.e., neither normal nor lognormal). A central tendency value is then selected from the distribution of the exposure values for each body part. These values are the arithmetic mean for normal distributions, the geometric mean for lognormal distributions, and the median for all "other" distributions. Once selected, the central tendency values for each body part are composited into a "best fit" exposure value representing the entire body.

The unit exposure values calculated by PHED generally range from the geometric mean to the median of the selected data set. While data from PHED provide the best available information on handler exposures, it should be noted that some aspects of the included studies (e.g., duration, acres treated, pounds of active ingredient handled) may not accurately represent labeled uses in all cases. HED has developed a series of tables of standard unit exposure values for many occupational scenarios that can be utilized to ensure consistency in exposure assessments (PHED Surrogate Exposure Guide, August 1998).[6]

In the revised assessment for occupational handlers, PHED data are used to assess exposure to scenarios (1) through (6), (8), (11), and (12).

Outdoor Residential Exposure Task Force (ORETF)

The handler exposure data for loading/applying granules with push-type spreader equipment used in this revised occupational and residential assessment are from the Outdoor Residential Exposure Task Force (ORETF).[7] The task force recently submitted proprietary data to the Agency on hose-end sprayers, push-type granular spreaders, and handgun sprayers (MRID # 44972201). The ORETF data were used in this assessment in place of PHED data for the "loading/applying granulars using a push-type spreader" scenario. The ORETF data were designed to replace the present PHED data with higher-confidence, higher quality data that contains more replicates than the PHED data for those scenarios.[6,7]

Proprietary Studies

***Worker Exposure Study During Application In Banana Plantation With Temik 10G*, EPA MRID 451672-01:**[8]

In the revised occupational risk assessment, EPA used data from the aldicarb (Temik) study to assess exposures and risks to handlers applying granulars with a pump feed backpack sprayer. In the original assessment, no data were available to assess this exposure scenario.

Exposure during the application of a granular formulation of the insecticide, aldicarb (i.e., Temik 10G), was monitored during granular backpack application to bananas for control of insects, mites, and nematodes. A total of 12 mixer/loader/applicator events during granular backpack (i.e., a specialized pump-feed device manufactured by Swissmex Rapid) application to bananas were monitored during August of 1998 on the island of Martinique is in the French West Indies. Weather was typical of the application season in that it was hot, humid, and rainy at points.

Monitoring was completed using whole body dosimeters, handwashes, facial wipes, and personal sampling pumps equipped with XAD resin/filter combination samplers. Temik 10G was supplied in 22 pound boxes which was loaded directly into the backpack devices (i.e., 4 to 8 boxes were used per replicate). The application rate for aldicarb used in this study is 20 grams of Temik 10G (i.e., 2 grams ai/plant) which is equivalent to about 3.56 lb ai/acre at approximately 2000 plants per acre. The numbers of acres treated ranged from approximately 2.5 to 5 acres. The pounds of active ingredient handled ranged from 8.8 up to 17.6 per replicate. Each applicator wore the whole body dosimeters covered by a cotton coverall, Tyvek gloves supplied with the Temik 10G formulation, and an apron on their backs between their backs and the backpack applicator. The Tyvek gloves were changed with each box of Temik 10G used. In many instances, the gloves were compromised because they were ripped. In one case, the gloves filled with rainwater. In many other cases, when the whole body dosimeters were removed, they were found to be wet and muddy.

Analysis of aldicarb and its sulfoxide and sulfone degradates was completed. The

residue levels were added together to obtain total exposure levels. The limits of quantification (LOQ) were 1.0 μg per sample for the whole-body dosimeters and handwashes (600 mL volume). The LOQ for the facial wipes was 0.10 μg per sample and 0.050 0.10 μg per sample for the air filters.
Field and laboratory recovery data were generated for all media for all residues measured (i.e., parent and metabolites). Field recovery data were generated in a manner that addressed field sampling, field storage, transport, laboratory storage, and analysis. Residues were corrected for the overall average field recovery for each residue/matrix combination. Generally, recovery data were adequate for all media/residue combinations. If the PHED grading criteria are applied all residue/matrix combinations (except facial wipes with sulfone residues) have at least grade "B" data and in many cases the data meet the grade "A" criteria. The grade "B" criteria require laboratory recovery data with an average of at least 80 percent and a coefficient of variation of 25 or less accompanied with field recoveries that are at least 50 percent but not exceeding 120 percent. The grade "A" criteria require laboratory recovery data with an average of at least 90 percent and a coefficient of variation of 15 or less accompanied with field recoveries that are at least 70 percent but not exceeding 120 percent.

Unit exposure values were calculated using the data from the study and a commercial spreadsheet program. The exposures that were calculated were normalized by the amount of chemical used, the duration of the application interval, and by the body weight of the individual applicators. For each calculation, the arithmetic mean, geometric mean, and various percentiles were calculated. No analyses were completed with these data to ascertain the exact type of distribution. The Agency typically uses the best fit values from the Pesticide Handlers Exposure Database which are representations of the central tendency. Considering the standard practice, the Agency will use the geometric mean for risk assessment purposes.

Unit Exposure Values						
Type	(mg exp./lb ai handled)		(mg exp./hour)		(mg exp./kg body weight/day)	
	Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation
Geo. Mean	0.0995	0.0042	0.3979	0.0169	0.0409	0.0017

***Worker Exposure Study During Application of Regent 20GR In Banana Plantation*, EPA MRID 452507-02**[9]

In the revised occupational risk assessment, EPA used data from the fipronil (Regent 20 GR) study to assess exposures and risks to handlers loading and applying granulars with a gravity feed backpack sprayer. In the original assessment, no data were available to assess this exposure scenario. In addition, in the revised occupational risk assessment, EPA used data from the fipronil study to assess exposures and risks to occupational handlers loading and applying granulars using a scoop and bucket. In the original assessment, PHED data for applying granulars by hand were used. However, this proprietary study is being substituted for the PHED data because the study data is higher-confidence and higher quality. The Agency notes that unit exposure values derived from the fipronil study and used in place of PHED data for the disulfoton assessment are range-finding estimates only.

Exposure during the application of a granular formulation of the insecticide, fipronil (i.e., Regent 20GR), was monitored during granular gravity-feed backpack (i.e., Horstine Farmery

Microspread®) applications and spoon applications to bananas for control of insects, mites, and nematodes. A total of 18 mixer/loader/applicator events during granular backpack (i.e., a specialized gravity-feed device manufactured by Horstine Farmery) or spoon application to bananas were monitored during applications on three different days in June, 1994 on the same banana plantation in Cameroon. The 18 replicates were distributed over the 3 sampling days as follows: 6 spoon/hand applications on day 1; 4 spoon/hand applications on day 2; and 8 backpack events on day 3. Weather was typical of the application season in that it was hot and humid. Monitoring was completed using whole body dosimeters, cotton gloves, cotton caps, and personal sampling pumps equipped with filters. Regent 20GR was supplied in 22 pound boxes which was loaded directly into the backpack devices or buckets for the spoon applicators. The application rate for fipronil used in this study is 7.5 grams of Regent 20GR (i.e., 0.15 grams ai/plant) which is equivalent to about 0.26 lb ai/acre (0.00033 lb ai/plant) at approximately 800 plants per acre. The numbers of acres treated ranged from approximately 0.75 to 1 acre. The pounds of active ingredient handled ranged from about a quarter to half a pound per replicate.

Each applicator wore whole body dosimeters that also served as the normal work clothing. PVC gloves were also worn over cotton gloves which served as the dosimeters. A protection factor of 50 percent was used by the Agency to calculate exposure levels under a layer of normal work clothing. Dosimeter samples were segmented into arms, legs, and torso for analysis.

Analysis of fipronil residues was completed with gas chromatography and electron capture detection. The limits of quantification (LOQ) were 9.7 μg per sample for all media used. The limit of detection (LOD) varied for each media. The LOD for the cotton gloves was 0.5 μg per sample, 0.10 μg per sample for the air filters, and 2.0 to 4.0 μg per sample for the whole body dosimeters depending upon the sample analyzed. Field and laboratory recovery data were generated for all media. Field recovery data were generated in a manner that addressed field sampling, field storage, transport, laboratory storage, and analysis. However, the laboratory recovery data were indeterminate because the sample media could not be identified for each reported result. The overall recovery values do appear to be quantitative. Residues were corrected for the overall average field recovery for each residue/matrix combination. Generally, recovery was adequate for all media/residue combinations (i.e., all correction factors were greater than 85 percent). If the PHED grading criteria are applied and the overall laboratory recovery averages are used all residue/matrix combinations are considered grade “A” data. The grade “A” criteria require laboratory recovery data with an average of at least 90 percent and a coefficient of variation of 15 or less accompanied with field recoveries that are at least 70 percent but not exceeding 120 percent.

Unit exposure values were calculated using the data from the study and a commercial spreadsheet program. The exposures that were calculated were normalized by the amount of chemical used, the duration of the application interval, and by the body weight of the individual applicators (see table below). The values are based on a 50 percent clothing penetration factor and are separated for each equipment type monitored in this study. For each normalization factor, the arithmetic mean, geometric mean, and various percentiles were calculated. No analyses were completed with these data to ascertain the exact type of distribution. The Agency typically uses the best fit values from the Pesticide Handlers Exposure Database which are

representations of the central tendency. Considering the standard practice, the Agency will use the geometric mean for risk assessment purposes.

Unit Exposure Values For Single Layer Clothing and Gloves						
Type	(mg exp./lb ai handled)		(mg exp./hour)		(mg exp./kg body weight/day)	
	Dermal	Inhalation	Dermal	Inhalation	Dermal	Inhalation
Applications with a Spoon						
Geo. Mean	1.978	0.045	0.246	0.006	0.014	0.0003
Applications with a Horstine Farmery Microspread						
Geo. Mean	0.598	0.044	0.056	0.004	0.003	0.0002

Occupational Handler Exposure Scenario Data and Assumptions

An exposure assessment for each scenario was developed, where appropriate data are available, using the *Pesticide Handlers Exposure Database (PHED) Version 1.1,*[6] ORETF data,[7] and proprietary data.[8,9] Appendix Table 5 summarizes the caveats and parameters specific to the surrogate data used for each scenario and corresponding exposure/risk assessment. These caveats include the source of the data and an assessment of the overall quality of the data. The assessment of data quality is based on the number of observations and the available quality control data. The quality control data are based on a grading criteria established by the PHED task force.[6]

The following assumptions and factors were used in order to complete this occupational exposure assessment:

- Average body weight of an adult handler is 70 kg.
- Average work day interval represents an 8 hour workday (e.g., the acres treated or volume of spray solution prepared in a typical day are based on an 8 hour workday).
- Calculations are completed at the maximum application rates for specific crops recommended by the available disulfoton labels to estimate reasonable worse-case risk levels associated with the various use patterns.
- Due to a lack of scenario-specific data, HED often calculates unit exposure values using generic protection factors (PF) that are applied to represent various risk mitigation options (i.e., the use of Personal Protective Equipment (PPE) and engineering controls). PPE protection factors include those representing a double layer of clothing (50 percent PF), chemical resistant gloves (90 percent PF) and respiratory protection (80 percent PF) for use of dust/mist mask. Engineering controls are generally assigned a PF of 98 percent.

Occupational Handler Exposure and Risk Estimates

The calculations of daily dermal and inhalation exposure, short-term and intermediate-term doses, and dermal, inhalation, and total short- and intermediate-term MOEs were made

using the following formulae.

Potential daily dermal exposure is calculated using the following formula:

$$Daily\ Dermal\ Exposure\left(\frac{mg\ ai}{day}\right) = Unit\ Exposure\left(\frac{mg\ ai}{lb\ ai}\right) x\ Use\ Rate\left(\frac{lb\ ai}{A}\right) x\ Daily\ Acres\ Treated\left(\frac{A}{day}\right)$$

The potential short-term and intermediate-term dermal doses were calculated using the following formulae:

$$Short\text{-}term\ Daily\ Dermal\ Dose\left(\frac{mg\ ai}{kg/day}\right) = Short\text{-}term\ Daily\ Dermal\ Exposure\left(\frac{mg\ ai}{day}\right) x\left(\frac{1}{Body\ Weight\ (kg)}\right)$$

$$Interm\text{-}term\ Daily\ Dermal\ Dose\left(\frac{mg\ ai}{kg/day}\right) = Interm\text{-}term\ Daily\ Dermal\ Exposure\left(\frac{mg\ ai}{day}\right) x\ DermalAbsorption\ (0.36)\ x\left(\frac{1}{BW\ (kg)}\right)$$

The short-term MOEs were calculated using a NOAEL of 0.5 mg/kg/day. The intermediate-term MOEs were calculated using a NOAEL of 0.03 mg/kg/day assuming 36 percent dermal absorption.

Potential daily inhalation exposure was calculated using the following formula:

$$Daily\ Inhalation\ Exposure\left(\frac{mg\ ai}{day}\right) =$$
$$Unit\ Exposure\left(\frac{\mu g\ ai}{lb\ ai}\right) x\ Conversion\ Factor\left(\frac{1\ mg}{1{,}000\ \mu g}\right) x\ Use\ Rate\left(\frac{lb\ ai}{A}\right) x\ Daily\ Acres\ Treated\left(\frac{A}{day}\right)$$

The potential short-term and intermediate-term inhalation doses were calculated using the following formulae:

$$Short\text{-}term\ Daily\ Inhalation\ Dose\left(\frac{mg\ ai}{kg/day}\right) = Short\text{-}term\ Daily\ Inhalation\ Exposure\left(\frac{mg\ ai}{day}\right) x\left(\frac{1}{Body\ Weight\ (kg)}\right)$$

$$Intermediate\text{-}term\ Daily\ Inhalation\ Dose\left(\frac{mg\ ai}{kg/day}\right) = Intermediate\text{-}term\ Daily\ Inhalation\ Exposure\left(\frac{mg\ ai}{day}\right) x\left(\frac{1}{Body\ Weight\ (kg)}\right)$$

For disulfoton, the inhalation doses were calculated using a 70 kg body weight and an inhalation absorption rate of 100 percent.

Occupational handler exposure assessments are completed by EPA using a baseline exposure scenario and, if required, increasing levels of risk mitigation (PPE and engineering

controls) to achieve an appropriate margin of exposure (MOE). The baseline scenario represents a handler wearing long pants, a long-sleeved shirt, and no chemical-resistant gloves. Table 3 below presents a summary of occupational handler risks of disulfoton by crop. The Appendix Tables 1 through 5 present risk assessment calculations for the occupational handling of disulfoton. Appendix Table 1 presents the dermal, inhalation, and total short- and intermediate-term risks at baseline attire. Appendix Table 2 presents the occupational dermal, inhalation, and total short-term risks when wearing PPE risk mitigation. Appendix Table 3 presents the occupational dermal, inhalation, and total intermediate-term risks when wearing PPE risk mitigation Appendix Table 4 presents the dermal, inhalation, and total short- and intermediate-term risks when engineering controls (e.g., closed systems for mixing/loading, enclosed cab for applying or flagging, and enclosed cockpit for aerial applications are used. Appendix Table 5 summarizes the caveats and parameters specific to the surrogate data used for each scenario and corresponding exposure/risk assessment.

Engineering Controls for Mixing and Loading

The engineering control available for mixing and loading pesticides is a closed system. In the Worker Protection Standard for Agricultural Pesticides (WPS) -- 40 CFR Parts 156 and 170, *closed systems* are defined as systems designed by the manufacturer to enclose the pesticide to prevent it from contacting handlers or other people while it is being handled. Such systems must function properly and be used and maintained in accordance with the manufacturer's written operating instructions. Under the WPS, when correctly using a closed system to mix and/or load pesticides, handlers need not wear all the personal protective equipment listed on the pesticide labeling for handlers, but must wear at least: long-sleeved shirt and long pants, shoes and socks, and chemical-resistant gloves specified on the pesticide labeling for mixing, loading, and other handling tasks. If the formulation is a liquid, a chemical-resistant apron is also required. The gloves and chemical-resistant apron are required to protect the mixers/loaders in case the closed systems breaks down. When using a closed system for liquid formulations that operates under pressure, handlers may wear the reduced PPE specified above, but must add protective eyewear even if the handler PPE does not require protective eyewear. NOTE: Under the WPS, when reduced PPE is worn because a closed system is being used, handlers must be provided all PPE specified on the labeling for handlers and have such PPE immediately available for use in a emergency, such as a spill or equipment break-down.

Closed Mixing/Loading Systems for Liquid Formulations. There are various types of closed systems currently available for use with liquid formulations:

- *Water-Soluble Packaging*: One closed system is a type of packaging system where the liquid pesticide is formulated by the registrant into a gel and packaged into water-soluble packets. When used correctly, water-soluble packaging qualifies as a closed loading system under the WPS. Water-soluble packaging provides both dermal and inhalation protection and is reflected in the risk assessment for mixing/loading liquid formulations under the columns for engineering controls **with inhalation protection** (i.e., engineering control inhalation). Handlers handling a product while it is enclosed in intact water-soluble packets are permitted to wear the reduced PPE described above, as long as

the full required PPE is immediately available.

- *Mechanical Closed Mixing System*: Another type of closed system for liquid formulations is a mechanical system operated by the users that consists of a probe that is inserted into the pesticide container (either by puncturing the container or through the container's opening) and seals tightly to the pesticide container to prevent leaks. A transfer pump may be used to move the pesticide from its original container to the sprayer tank or the closed-system equipment may be connected to the pressure system of the sprayer itself. Some type of metering device is used to measure the quantity of pesticide being transferred. This type of system provides both dermal and respiratory protection and is reflected in the risk assessment for mixing/loading liquid formulations under the columns for engineering controls **with inhalation protection** (i.e., engineering control inhalation). Handlers using this closed system are permitted to wear reduced PPE describe above, as long as the full required PPE is immediately available. NOTE: If the closed mixing system does not automatically rinse the container for return to the tank, a handler wearing full PPE must rinse the container and add the rinsate to the spray tank.

- *Mechanical Transfer System*: A mechanical transfer system usually does not meet the definition of a closed system under the WPS, unless inhalation exposure is not a concern. A Mechanical Transfer System is designed by the manufacturer to transfer liquid pesticide in a manner that prevents the liquid (but not necessarily any vapor) from contacting handlers or other people during the transfer. Often the systems are equipped with dry-disconnect fittings. However, a probe and pump system without dry-disconnect fittings also is a mechanical transfer system. This type of system provides both dermal and respiratory protection and is reflected in the risk assessment for mixing/loading liquid formulations under the columns for engineering controls **with no inhalation protection** (i.e., baseline inhalation). If inhalation is not a concern for mixers and loaders, the Agency may determine that a mechanical transfer system (particularly coupled with a dry-disconnect system -- see below), when functioning correctly and used and maintained in accordance with the manufacturer's written operating instructions, qualifies as a closed system and permit handlers using this system to wear reduced PPE described above, as long as the full required PPE is immediately available.

- *Dry-Disconnect System*: A dry-disconnect systems does not meet the definition of a closed system under the WPS unless it is part of a mechanical closed system. Dry-disconnect systems are fittings designed by the manufacturer to minimize pesticide leakage at each hose disconnect point. These systems are often used in conjunction with mechanical transfer systems. Dry-disconnect systems greatly reduce leakage of liquid when connecting pipes or hoses are uncoupled from equipment or from other pipes or hoses.

Closed Loading Systems for Granular Formulations. Currently, the only engineering control for loading granular formulations are proprietary systems with proprietary names, such as "LockNLoad" or "Smartbox." These closed systems are a type of packaging system where the granular pesticide is packaged by the registrant into specially designed containers that fit onto specific application equipment. When used correctly, these granular packaging systems qualify as a closed loading system under the WPS. Such packaging systems provides both dermal and inhalation protection and are reflected in the risk assessment for loading granular formulations into tractor-drawn spreader equipment under the columns for engineering controls **with inhalation protection** (i.e., engineering control inhalation). Handlers handling a granulars in these special packing systems are permitted to wear the reduced PPE described above, as long as the full required PPE is immediately available. **NOTE:** currently, the Agency is unaware of any closed systems for granular formulations that are compatible with aerial application equipment. However, EPA believes that such systems are feasible and reflected them in the disulfoton risk assessment to promote the development of closed systems for loading granular formulations into aerial equipment. When developed, such packaging systems are expected to provide both dermal and inhalation protection and are reflected in the risk assessment for loading granular formulations into aerial equipment under the columns for engineering controls **with inhalation protection** (i.e., engineering control inhalation).

Engineering Controls for Application

Enclosed Cockpits for Aerial Application. The engineering control available for applying pesticides in aerial equipment is an enclosed cockpit. The Agency assumes that an enclosed cockpit provides dermal and inhalation protection and it is reflected in the risk assessment for aerial application under the columns for engineering controls **with inhalation protection** (i.e., engineering control inhalation). In the Worker Protection Standard for Agricultural Pesticides (WPS) -- 40 CFR Parts 156 and 170, applicators in an *enclosed cockpit* need not wear all the PPE listed on the pesticide labeling, but must wear at least: long-sleeved shirt, and long pants, shoes, and socks. In addition, such applicators must (1) wear chemical-resistant gloves when entering or leaving an aircraft contaminated by pesticide residues, and (2) store used gloves in a closed, chemical-resistant container, such as a plastic bag, to prevent contamination of the inside of the cockpit.

Enclosed Cabs for Motorized Ground Application. The engineering control available for applying pesticides in motorized ground equipment is an enclosed cab. In the Worker Protection Standard for Agricultural Pesticides (WPS) -- 40 CFR Parts 156 and 170, an *enclosed cab* must have a nonporous barrier that totally surrounds the occupants and prevents contact with pesticides outside of the cab. If inhalation is not a concern for ground applicators (i.e., no inhalation protection is required), any enclosed cab that surrounds occupants with a nonporous barrier meets the definition of enclosed cab. Enclosed cabs that provide dermal protection only are reflected in the risk assessment for ground equipment application (i.e., groundboom and tractor-drawn spreader) under the columns for engineering controls **with no inhalation protection** (i.e., baseline inhalation). If the risks with no inhalation protection are of concern, then the occupants of the enclosed cabs must either wear the appropriate type of respirator or use an enclosed cab that provides the appropriate level of respiratory protection. The risks for such

situations are reflected in the risk assessment for ground equipment application under the columns for engineering controls **with inhalation protection** (i.e., engineering control inhalation). Some enclosed-cab systems provide respiratory protection equivalent to a dust/mist filtering respirator and could, therefore, be used as a substitute when that type of respirator is specified on the product labeling. Other enclosed-cab systems are equipped to remove organic vapors as well as dusts and mists and could be used as a substitute when either the dust/mist filtering respirator or an organic-vapor-removing respirator is specified on the product labeling. Enclosed cabs that provide respiratory protection must have a properly functioning ventilation system that is used and maintained according to the manufacturer's written operating instructions. The cab must be declared in writing by the manufacturer or by a governmental agency to provide at least as much respiratory protection as the type of respirator listed on the pesticide labeling. **NOTE:** Occupants of enclosed cabs need not wear all the PPE listed on the pesticide labeling, but must wear at least: long-sleeved shirt and long pants, shoes and socks. They must also wear a respirator inside the enclosed cab if a respirator is listed on the labeling for ground equipment applicators, *unless* the enclosed cab provides respiratory protection equivalent to the type of respirator required. In any enclosed cab where reduced PPE is worn, handlers must: (1) keep immediately available all PPE listed on the labeling for the type of task being performed, (2) wear the PPE if it is necessary to leave the cab and contact pesticide-treated surfaces in the treated area, (3) take off PPE that was worn in the treated area before reentering the cab, and (4) store all PPE in a chemical-resistant container, such as a plastic bag, to prevent contamination of the inside of the cab.

Engineering Controls for Flagging

The engineering controls available for flagging to support aerial applications is enclosed cabs and mechanical or remote flaggers. The enclosed cab engineering control is the same as the enclosed cab described under *Enclosed Cabs for Motorized Ground Application*. By definition, mechanical flaggers and other remote flagging devices do not result in significant exposures to humans.

TABLE 3: SUMMARY OF HANDLER RISKS FOR DISULFOTON BY CROP

Crop	Handler Scenario	Application Rate / Area Treated [a,b]	Baseline Total MOE[c] (UF=100)		PPE (Gloves) Total MOE[c] (UF=100)				PPE (Gloves + Double Layers) Total MOE[c] (UF=100)				Engineering Controls Total MOE[c] (UF=100)			
			Short-T	Inter.-T	Short-T		Inter.-T		Short-T		Inter.-T		Short-T		Inter.-T	
					No R	Resp	No R	Resp	No R	Resp	No R	Resp	No I	Inh	No I	Inh
Tobacco	Mixing/loading liquid formulation for aerial application	4 lb/A & 350 A	0.0086	0.0014	0.69	0.97	0.17	0.18	0.82	1.3	0.22	0.24	1.1	2.6	0.39	0.48
	Applying sprays with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	4.3	NF	0.81
	Flagging for aerial spray applications		1.7	0.36	N\A	N\A	N\A	N\A	1.8 NG	2.3 NG	0.39 NG	0.41 NG	6.1	84	4.8	18
	Loading granular formulations for aerial application	4 lb/A & 350 A	0.92	0.36	0.97	2.3	0.41	0.55	1.1	3.5	0.64	1	NF	46	NF	18
	Applying granules with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	1.5	NF	1
	Flagging for aerial granular applications		5.6	1.4	N\A	N\A	N\A	N\A	7.7 NG	13 NG	2.2 NG	2.5 NG	15	280	12	68
	Mixing/loading liquid formulation for groundboom application	4 lb/A & 80 A	0.038	0.0063	3	4.3	0.72	0.78	3.6	5.6	0.95	1	5	11	1.7	2.1
	Applying sprays with groundboom equipment		4.9	1.2	4.9	7	1.2	1.3	5.7	8.6	1.5	1.6	8.3	20	2.9	3.6
	Loading granular formulations for ground application	4 lb/A & 80 A	4	1.6	4.2	10	1.8	2.4	4.9	15	2.8	4.5	NF	200	NF	78
	Applying granules with tractor-drawn spreader		4.7	1.5	5.3	11	1.9	2.4	6.2	16	2.8	3.9	7.1	24	4.2	7.3
Asparagus (SLN)	Mixing/loading liquid formulation for aerial application	1 lb/A & 350	0.034	0.0057	2.8	3.9	0.66	0.71	3.3	5.1	0.87	0.96	4.6	11	1.5	1.9
	Applying sprays with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	17	NF	3.3
	Flagging for aerial spray applications		6.7	1.4	N\A	N\A	N\A	N\A	7.2 NG	9.3 NG	1.6 NG	1.6 NG	24	340	19	72
	Mixing/loading liquid formulation for groundboom application	1 lb/A & 80	0.15	0.025	12	17	2.9	3.1	14	22	3.8	4.2	20	46	6.7	8.3
	Applying sprays with groundboom equipment		20	4.7	20	28	4.7	5.1	23	35	5.9	6.5	33	80	11	14
Barley	Mixing/loading liquid formulation for aerial application	1 lb/A & 1200 A	0.01	0.0017	0.8	1.1	0.19	0.21	0.96	1.5	0.25	0.28	1.3	3.1	0.45	0.56
	Applying sprays with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	5.1	NF	0.95
	Flagging for aerial spray applications	1 lb/A & 1200 A	2	0.42	N\A	N\A	N\A	N\A	2.1 NG	2.7 NG	0.46 NG	0.48 NG	7.1	98	5.6	21

TABLE 3: SUMMARY OF HANDLER RISKS FOR DISULFOTON BY CROP continued

Crop	Handler Scenario	Application Rate / Area Treated [a,b]	Baseline Total MOE[c] (UF=100)		PPE (Gloves) Total MOE[c] (UF=100)				PPE (Gloves + Double Layers) Total MOE[c] (UF=100)				Engineering Controls Total MOE[c] (UF=100)			
			Short-T	Inter.-T	Short-T		Inter.-T		Short-T		Inter.-T		Short-T		Inter.-T	
					No R	Resp	No R	Resp	No R	Resp	No R	Resp	No I	Inh	No I	Inh
		1 lb/A & 350 A	6.7	1.4	N\A	N\A	N\A	N\A	7.2 NG	9.3 NG	1.6 NG	1.6 NG	24	340	19	72
	Loading granular formulations for aerial application	1 lb/A & 1200 A	1.1	0.42	1.1	2.7	0.48	0.65	1.3	4.1	0.74	1.2	NF	53	NF	21
	Applying granules with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	1.8	NF	1.2
	Flagging for aerial granular applications	1 lb/A & 1200 A	6.5	1.6	N\A	N\A	N\A	N\A	8.9 NG	15 NG	2.6 NG	2.9 NG	17	330	15	79
		1 lb/A & 350 A	5.6	1.4	N\A	N\A	N\A	N\A	7.7 NG	13 NG	2.2 NG	2.5 NG	15	280	12	22
	Mixing/loading liquid formulation for groundboom application	1 lb/A & 200 A	0.06	0.01	5.8	8.9	1.2	1.2	4.8	6.8	1.5	1.7	8	18	2.7	3.3
	Applying sprays with groundboom equipment		7.9	1.9	7.9	11	1.9	2	9.1	14	2.4	2.6	13	32	4.6	5.7
	Loading granular formulations for ground application	1 lb/A & 200 A	6.4	2.5	6.8	16	2.9	3.9	7.9	24	4.5	7.2	NF	320	NF	130
	Applying granules with tractor-drawn spreader		7.5	2.4	8.5	18	3.1	3.8	10	25	4.5	6.3	11	39	6.7	12
Soybeans	Loading granular formulations for ground application	1 lb/A & 200 A	6.4	2.5	6.8	16	2.9	3.9	7.9	24	4.5	7.2	NF	320	NF	120
	Applying granules with tractor-drawn spreader		7.5	2.4	8.5	18	3.1	3.8	10	25	4.5	6.3	11	39	6.7	12
Wheat	Mixing/loading liquid formulation for aerial application	0.75/A & 1200 A	0.013	0.0022	1.1	1.5	0.26	0.28	1.3	2	0.34	0.37	1.8	4.1	0.6	0.74
	Applying sprays with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	6.8	NF	1.3
	Flagging for aerial spray applications	0.75/A & 1200 A	2.6	0.56	N\A	N\A	N\A	N\A	2.8 NG	3.6 NG	0.61 NG	0.64 NG	9.5	130	7.5	28
		0.75/A & 350 A	9	1.9	N\A	N\A	N\A	N\A	9.6 NG	12 NG	2.1 NG	2.2 NG	32	450	26	95
	Loading granular formulations for aerial application	1 lb/A & 1200 A	1.1	0.42	1.1	2.7	0.48	0.65	1.3	4.1	0.74	1.2	NF	53	NF	21
	Applying granules with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	1.8	NF	1.2
	Flagging for aerial granular applications	1 lb/A & 1200 A	6.5	1.6	N\A	N\A	N\A	N\A	8.9 NG	15 NG	2.6 NG	2.9 NG	17	330	15	79

TABLE 3: SUMMARY OF HANDLER RISKS FOR DISULFOTON BY CROP continued

Crop	Handler Scenario	Application Rate / Area Treated [a,b]	Baseline Total MOE[c] (UF=100)		PPE (Gloves) Total MOE[c] (UF=100)				PPE (Gloves + Double Layers) Total MOE[c] (UF=100)				Engineering Controls Total MOE[c] (UF=100)			
			Short-T	Inter.-T	Short-T		Inter.-T		Short-T		Inter.-T		Short-T		Inter.-T	
					No R	Resp	No R	Resp	No R	Resp	No R	Resp	No I	Inh	No I	Inh
		1 lb/A & 350 A	5.6	1.4	N\A	N\A	N\A	N\A	7.7 NG	13 NG	2.2 NG	2.5 NG	15	280	12	68
	Mixing/loading liquid formulation for groundboom application	1 lb/A & 200 A	0.06	0.01	4.8	6.8	1.2	1.2	5.8	8.9	1.5	1.7	8	18	2.7	3.3
	Applying sprays with groundboom equipment		7.9	1.9	7.9	11	1.9	2	9.1	14	2.4	2.6	13	32	4.6	5.7
	Loading granular formulations for ground application	1 lb/A & 200 A	6.4	2.5	6.8	16	2.9	3.9	7.9	24	4.5	7.2	NF	320	NF	130
	Applying granules with tractor-drawn spreader		7.5	2.4	8.5	18	3.1	3.8	10	25	4.5	6.3	11	39	6.7	12
Sorghum	Mixing/loading liquid formulation for aerial application	0.5/A & 1200 A	0.02	0.0033	1.6	2.3	0.39	0.41	1.9	3	0.51	0.56	2.7	6.1	0.9	1.1
	Applying sprays with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	10	NF	1.9
	Flagging for aerial spray applications	0.5/A & 1200 A	3.9	0.83	N\A	N\A	N\A	N\A	4.2 NG	5.4 NG	0.91 NG	0.96 NG	14	200	11	42
		0.5/A & 350 A	13	2.9	N\A	N\A	N\A	N\A	14 NG	19 NG	3.1 NG	3.3 NG	49	670	38	140
	Loading granular formulations for aerial application	1 lb/A & 1200 A	1.1	0.42	1.1	2.7	0.48	0.65	1.3	4.1	0.74	1.2	NF	53	NF	21
	Applying granules with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	1.8	NF	1.2
	Flagging for aerial granular applications	1 lb/A & 1200 A	6.5	1.6	N\A	N\A	N\A	N\A	8.9 NG	15 NG	2.6 NG	2.9 NG	17	330	15	79
		1 lb/A & 350 A	22	5.5	N\A	N\A	N\A	N\A	31 NG	52 NG	8.9 NG	10 NG	58	1100	50	270
	Mixing/loading liquid formulation for groundboom application	1 lb/A & 200 A	0.06	0.01	4.8	6.8	1.2	1.2	5.8	8.9	1.5	1.7	8	18	2.7	3.3
	Applying sprays with groundboom equipment		7.9	1.9	7.9	11	1.9	2	9.1	14	2.4	2.6	13	32	4.6	5.7
	Loading granular formulations for ground application	1 lb/A & 200 A	6.4	2.5	6.8	16	2.9	3.9	7.9	24	4.5	7.2	NF	320	NF	130
	Applying granules with tractor-drawn spreader		7.5	2.4	8.5	18	3.1	3.8	10	25	4.5	6.3	11	39	6.7	12
Potatoes (foliar)	Mixing/loading liquid formulation for aerial application	0.5/lbA & 350 A	0.069	0.011	5.5	7.8	1.3	1.4	6.6	10	1.7	1.9	9.1	21	3.1	3.8

TABLE 3: SUMMARY OF HANDLER RISKS FOR DISULFOTON BY CROP continued

Crop	Handler Scenario	Application Rate / Area Treated [a,b]	Baseline Total MOE[c] (UF=100)		PPE (Gloves) Total MOE[c] (UF=100)				PPE (Gloves + Double Layers) Total MOE[c] (UF=100)				Engineering Controls Total MOE[c] (UF=100)			
			Short-T	Inter.-T	Short-T		Inter.-T		Short-T		Inter.-T		Short-T		Inter.-T	
					No R	Resp	No R	Resp	No R	Resp	No R	Resp	No I	Inh	No I	Inh
	Applying sprays with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	35	NF	6.5
	Flagging for aerial spray applications		13	2.9	N\A	N\A	N\A	N\A	14 NG	19 NG	3.1 NG	3.3 NG	49	670	38	140
	Mixing/loading/applying liquid formulation through chemigation (OR, WA, ID, UT)	3.0 lb/A & 350 A	0.011	0.0019	0.92	1.3	0.22	0.24	1.1	1.7	0.29	0.32	1.5	3.5	0.51	0.63
	Mixing/loading liquid formulation for groundboom application	0.5 lb/A & 80 A	0.3	0.05	24	34	5.8	6.2	29	44	7.6	8.4	40	92	13	17
	Applying sprays with groundboom equipment		39	9.5	39	56	9.5	10	46	69	12	13	66	160	23	29
Potatoes (soil-directed)	Mixing/loading liquid formulation for groundboom application	3 lb/A & 80 A	0.05	0.0084	4	5.7	0.96	1	4.8	7.4	1.3	1.4	6.6	15	2.2	2.8
	Applying sprays with groundboom equipment		6.6	1.6	6.6	9.3	1.6	1.7	7.6	12	2	2.2	11	27	3.8	4.8
	Loading granular formulations for aerial application	3 lb/A & 350 A	1.2	0.48	1.3	3.1	0.55	0.74	1.5	4.6	0.85	1.4	NF	61	NF	24
	Applying granules with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	2.1	NF	1.4
	Flagging for aerial granular applications		7.5	1.8	N\A	N\A	N\A	N\A	10 NG	17 NG	3 NG	3.4 NG	19	370	17	90
	Loading granular formulations for ground application	3 lb/A & 80 A	5.3	2.1	5.7	14	2.4	3.2	6.5	20	3.7	6	NF	270	NF	100
	Applying granules with tractor-drawn spreader		6.3	2	7.1	15	2.6	3.2	8.3	21	3.8	5.2	9.4	32	5.6	9.7
Cotton (SLN)	Mixing/loading liquid formulation for aerial application	0.2 lb/A & 1200 A	0.05	0.0084	4	5.7	0.96	1	4.8	7.4	1.3	1.4	6.6	15	2.2	2.8
	Applying sprays with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	25	NF	4.7
	Flagging for aerial spray applications	0.2 lb/A & 1200 A	34	7.2	N\A	N\A	N\A	N\A	36 NG	46 NG	7.8 NG	8.2 NG	120	1700	96	360
		0.2 lb/A & 350 A	9.8	2.1	N\A	N\A	N\A	N\A	11 NG	14 NG	2.3 NG	2.4 NG	35	490	28	100
Cotton	Mixing/loading/applying liquid formulation through chemigation	1 lb/A & 350 A	0.034	0.0057	2.8	3.9	0.66	0.71	3.3	5.1	0.87	0.96	4.6	11	1.5	1.9
	Mixing/loading liquid formulation for groundboom application	1 lb/A & 200 A	0.06	0.01	4.8	6.8	1.2	1.2	5.8	8.9	1.5	1.7	8	18	2.7	3.3

TABLE 3: SUMMARY OF HANDLER RISKS FOR DISULFOTON BY CROP continued

Crop	Handler Scenario	Application Rate / Area Treated [a,b]	Baseline Total MOE[c] (UF=100)		PPE (Gloves) Total MOE[c] (UF=100)				PPE (Gloves + Double Layers) Total MOE[c] (UF=100)				Engineering Controls Total MOE[c] (UF=100)			
			Short-T	Inter.-T	Short-T		Inter.-T		Short-T		Inter.-T		Short-T		Inter.-T	
					No R	Resp	No R	Resp	No R	Resp	No R	Resp	No I	Inh	No I	Inh
	Applying sprays with groundboom equipment		7.9	1.9	7.9	11	1.9	2	9.1	14	2.4	2.6	13	32	4.6	5.7
	Loading granular formulations for ground application	1 lb/A & 200 A	6.4	2.5	6.8	16	2.9	3.9	7.9	24	4.5	7.2	NF	320	NF	130
	Applying granules with tractor-drawn spreader		7.5	2.4	8.5	18	3.1	3.8	10	25	4.5	6.3	11	39	6.7	12
Poplars Grown for Pulpwood (SLN)	Mixing/loading/applying liquid formulation through chemigation	3 lb/A & 350 A	0.011	0.0019	0.92	1.3	0.22	0.24	1.1	1.7	0.29	0.32	1.5	3.5	0.51	0.63
	Mixing/loading liquid formulation for groundboom application	3 lb/A & 80 A	0.05	0.0084	4	5.7	0.96	1	4.8	7.4	1.3	1.4	6.6	15	2.2	2.8
	Applying sprays with groundboom equipment		6.6	1.6	6.6	9.3	1.6	1.7	7.6	12	2	2.2	11	27	3.8	4.8
Cabbage	Mixing/loading/applying liquid formulation through chemigation	2 lb/A & 350 A	0.017	0.0029	1.4	1.9	0.33	0.36	1.6	2.5	0.43	0.48	2.3	5.3	0.77	0.95
	Mixing/loading liquid formulation for groundboom application	2 lb/A & 80 A	0.075	0.013	6	8.5	1.4	1.6	7.2	11	1.9	2.1	10	23	3.4	4.2
	Applying sprays with groundboom equipment		9.8	2.4	9.8	14	2.4	2.6	11	17	2.9	3.2	17	40	5.7	7.2
	Loading granular formulations for ground application	1.5 lb/A & 80 A	11	4.2	11	27	4.8	6.5	13	41	7.4	12	NF	530	NF	210
	Applying granules with tractor-drawn spreader		13	4	14	30	5.2	6.4	17	42	7.6	10	19	64	11	19
Lettuce	Mixing/loading/applying liquid formulation through chemigation	2 lb/A & 350 A	0.017	0.0029	1.4	1.9	0.33	0.36	1.6	2.5	0.43	0.48	2.3	5.3	0.77	0.95
	Mixing/loading liquid formulation for groundboom application	2 lb/A & 80 A	0.075	0.013	6	8.5	1.4	1.6	7.2	11	1.9	2.1	10	23	3.4	4.2
	Applying sprays with groundboom equipment		9.8	2.4	9.8	14	2.4	2.6	11	17	2.9	3.2	17	40	5.7	7.2
Broccoli, Brussels sprouts, cauliflower	Mixing/loading/applying liquid formulation through chemigation	1 lb/A & 350 A	0.034	0.0057	2.8	3.9	0.66	0.71	3.3	5.1	0.87	0.96	4.6	11	1.5	1.9
	Mixing/loading liquid formulation for groundboom application	1 lb/A & 80 A	0.15	0.025	12	17	2.9	3.1	14	22	3.8	4.2	20	46	6.7	8.3
	Applying sprays with groundboom equipment		20	4.7	20	28	4.7	5.1	23	35	5.9	6.5	33	80	11	14

TABLE 3: SUMMARY OF HANDLER RISKS FOR DISULFOTON BY CROP continued

Crop	Handler Scenario	Application Rate / Area Treated [a,b]	Baseline Total MOE[c] (UF=100)		PPE (Gloves) Total MOE[c] (UF=100)				PPE (Gloves + Double Layers) Total MOE[c] (UF=100)				Engineering Controls Total MOE[c] (UF=100)			
			Short-T	Inter.-T	Short-T		Inter.-T		Short-T		Inter.-T		Short-T		Inter.-T	
					No R	Resp	No R	Resp	No R	Resp	No R	Resp	No I	Inh	No I	Inh
	Loading granular formulations for ground application	1 lb/A & 80 A	16	6.3	17	41	7.3	9.7	20	61	11	18	NF	800	NF	310
	Applying granules with tractor-drawn spreader		19	6	21	44	7.7	9.5	25	64	11	16	28	96	17	29
Peas, Lentils	Mixing/loading liquid formulation for groundboom application	2.5 lb/A & 80 A	0.06	0.01	4.8	6.8	1.2	1.2	5.8	8.9	1.5	1.7	8	18	2.7	3.3
	Applying sprays with groundboom equipment		7.9	1.9	7.9	11	1.9	2	9.1	14	2.4	2.6	13	32	4.6	5.7
	Loading granular formulations for aerial application	2.5 lb/A & 350 A	1.5	0.58	1.6	3.7	0.66	0.89	1.8	5.6	1	1.7	NF	73	NF	29
	Applying granules with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	2.5	NF	1.6
	Flagging for aerial granular applications		9	2.2	N\A	N\A	N\A	N\A	12 NG	21 NG	3.6 NG	4 NG	23	450	20	110
	Loading granular formulations for ground application	2.5 lb/A & 80 A	6.4	2.5	6.8	16	2.9	3.9	7.9	24	4.5	7.2	NF	320	NF	130
	Applying granules with tractor-drawn spreader		7.5	2.4	8.5	18	3.1	3.8	10	25	4.5	6.3	11	39	6.7	12
Beans (dry, snap, lima)	Mixing/loading liquid formulation for groundboom application	2 lb/A & 80 A	0.075	0.013	6	8.5	1.4	1.6	7.2	11	1.9	2.1	10	23	3.4	4.2
	Applying sprays with groundboom equipment		9.8	2.4	9.8	14	2.4	2.6	11	17	2.9	3.2	17	40	5.7	7.2
	Loading granular formulations for ground application	1 lb/A & 80 A	16	6.3	17	41	7.3	9.7	20	61	11	18	NF	800	NF	310
	Applying granules with tractor-drawn spreader		19	6	21	44	7.7	9.5	25	64	11	16	28	96	17	29
Peppers, Radish grown for seed (SLN)	Mixing/loading liquid formulation for groundboom application	2 lb/A & 80 A	0.075	0.013	6	8.5	1.4	1.6	7.2	11	1.9	2.1	10	23	3.4	4.2
	Applying sprays with groundboom equipment		9.8	2.4	9.8	14	2.4	2.6	11	17	2.9	3.2	17	40	5.7	7.2
	Loading granular formulations for ground application	2 lb/A & 80 A	8	3.2	8.5	20	3.6	4.8	9.8	30	5.6	9	NF	400	NF	160
	Applying granules with tractor-drawn spreader		9.4	3	11	22	3.9	4.8	12	32	5.7	7.8	14	48	8.4	15

TABLE 3: SUMMARY OF HANDLER RISKS FOR DISULFOTON BY CROP continued

Crop	Handler Scenario	Application Rate / Area Treated [a,b]	Baseline Total MOE[c] (UF=100)		PPE (Gloves) Total MOE[c] (UF=100)				PPE (Gloves + Double Layers) Total MOE[c] (UF=100)				Engineering Controls Total MOE[c] (UF=100)			
			Short-T	Inter.-T	Short-T		Inter.-T		Short-T		Inter.-T		Short-T		Inter.-T	
					No R	Resp	No R	Resp	No R	Resp	No R	Resp	No I	Inh	No I	Inh
Peanuts (SLN)	Loading granular formulations for aerial application	2 lb/A & 350 A	1.8	0.72	1.9	4.7	0.83	1.1	2.2	7	1.3	2.1	NF	91	NF	36
	Applying granules with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	3.1	NF	2
	Flagging for aerial granular applications		11	2.7	N\A	N\A	N\A	N\A	15 NG	26 NG	4.4 NG	5 NG	29	560	25	140
	Loading granular formulations for ground application	2 lb/A & 80 A	8	3.2	8.5	20	3.6	4.8	9.8	30	5.6	9	NF	400	NF	160
	Applying granules with tractor-drawn spreader		9.4	3	11	22	3.9	4.8	12	32	5.7	7.8	14	48	8.4	15
Peanuts	Loading granular formulations for ground application	1 lb/A & 80 A	16	6.3	17	41	7.3	9.7	20	61	11	18	NF	800	NF	310
	Applying granules with tractor-drawn spreader		19	6	21	44	7.7	9.5	25	64	11	16	28	96	17	29
Clover grown for seed (SLN)	Loading granular formulations for aerial application	1 lb/A & 350 A	3.7	1.4	3.9	9.4	1.7	2.2	4.5	14	2.5	4.1	NF	180	NF	72
	Applying granules with aircraft		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NF	6.2	NF	4.1
	Flagging for aerial granular applications		22	5.4	N\A	N\A	N\A	N\A	31 NG	52 NG	8.9 NG	10 NG	58	1100	50	270
	Loading granular formulations for ground application	1 lb/A & 80 A	16	6.3	17	41	7.3	9.7	20	61	11	18	NF	800	NF	310
	Applying granules with tractor-drawn spreader		19	6	21	44	7.7	9.5	25	64	11	16	28	96	17	29
Field Grown Ornamental Shrubs	Loading granular formulations for ground application	109 lb/A & 40 A	0.29	0.12	0.31	0.75	0.13	0.18	0.36	1.1	0.2	0.33	NF	15	NF	5.7
	Applying granules with tractor-drawn spreader		0.35	0.11	0.39	0.81	0.14	0.18	0.46	1.2	0.21	0.29	0.52	1.8	0.31	0.53
	Loading/Applying with Push Type Spreader	109 lb/A & 5 A	0.15	0.029	0.21	0.27	0.046	0.048	0.33	0.51	0.086	0.095	NF	NF	NF	NF
	Loading/Applying with Bellygrinder	109 lb/A & 1 A	0.03	0.0053	0.032	0.034	0.0057	0.0057	0.05	0.055	0.0092	0.0094	NF	NF	NF	NF
	Loading/Applying with Pump Feed Backpack Spreader	109 lb/A & 10 A	ND	ND	0.57 AP	1.7 AP	0.3 AP	0.46 AP	ND	ND	ND	ND	NF	NF	NF	NF
		109 lb/A & 5 A	ND	ND	1.1 AP	3.3 AP	0.6 AP	0.93 AP	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Gravity Feed Backpack Spreader	109 lb/A & 10 A	ND	ND	0.029	0.046	0.0079	0.0087	ND	ND	ND	ND	NF	NF	NF	NF
		109 lb/A & 5 A	ND	ND	0.059	0.092	0.016	0.017	ND	ND	ND	ND	NF	NF	NF	NF

TABLE 3: SUMMARY OF HANDLER RISKS FOR DISULFOTON BY CROP continued

Crop	Handler Scenario	Application Rate / Area Treated [a,b]	Baseline Total MOE[c] (UF=100)		PPE (Gloves) Total MOE[c] (UF=100)				PPE (Gloves + Double Layers) Total MOE[c] (UF=100)				Engineering Controls Total MOE[c] (UF=100)			
			Short-T	Inter.-T	Short-T		Inter.-T		Short-T		Inter.-T		Short-T		Inter.-T	
					No R	Resp	No R	Resp	No R	Resp	No R	Resp	No I	Inh	No I	Inh
	Loading/Applying with Scoop and Bucket	109 lb/A & 10 A	ND	ND	0.013	0.015	0.0026	0.0027	ND	ND	ND	ND	NF	NF	NF	NF
		109 lb/A & 5 A	ND	ND	0.026	0.031	0.0051	0.0053	ND	ND	ND	ND	NF	NF	NF	NF
Field Grown Ornamental Trees	Loading granular formulations for ground application	37 lb/A & 40 A	0.87	0.34	0.92	2.2	0.39	0.52	1.1	3.3	0.6	0.98	NF	43	NF	17
	Applying granules with tractor-drawn spreader		1	0.33	1.2	2.4	0.42	0.52	1.3	3.4	0.61	0.85	1.5	5.2	0.91	1.6
	Loading/Applying with Push Type Spreader	37 lb/A & 5 A	0.44	0.087	0.62	0.8	0.13	0.14	0.98	1.5	0.25	0.28	NF	NF	NF	NF
	Loading/Applying with Bellygrinder	37 lb/A & 1 A	0.088	0.016	0.095	0.1	0.017	0.017	0.15	0.16	0.027	0.028	NF	NF	NF	NF
	Loading/Applying with Pump Feed Backpack Spreader	37 lb/A & 10 A	ND	ND	1.7 AP	4.9 AP	0.89 AP	1.4 AP	ND	ND	ND	ND	NF	NF	NF	NF
		37 lb/A & 5 A	ND	ND	3.3 AP	9.8 AP	1.8 AP	2.7 AP	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Gravity Feed Backpack Spreader	37 lb/A & 10 A	ND	ND	0.087	0.14	0.023	0.026	ND	ND	ND	ND	NF	NF	NF	NF
		37 lb/A & 5 A	ND	ND	0.17	0.27	0.046	0.051	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Scoop and Bucket	37 lb/A & 10 A	ND	ND	0.038	0.045	0.0076	0.0078	ND	ND	ND	ND	NF	NF	NF	NF
		37 lb/A & 5 A	ND	ND	0.076	0.09	0.015	0.016	ND	ND	ND	ND	NF	NF	NF	NF
Field Grown Ornamental Flowers and Groundcover	Loading granular formulations for ground application	29 lb/A & 40 A	1.1	0.44	1.2	2.8	0.5	0.67	1.4	4.2	0.77	1.2	NF	55	NF	22
	Applying granules with tractor-drawn spreader		1.3	0.41	1.5	3.1	0.53	0.66	1.7	4.4	0.78	1.1	2	6.6	1.2	2
	Loading/Applying with Push Type Spreader	29 lb/A & 5 A	0.56	0.11	0.8	1	0.17	0.18	1.2	1.9	0.32	0.36	NF	NF	NF	NF
	Loading/Applying with Bellygrinder	29 lb/A & 1 A	0.11	0.02	0.12	0.13	0.021	0.022	0.19	0.21	0.035	0.035	NF	NF	NF	NF
	Loading/Applying with Pump Feed Backpack Spreader	29 lb/A & 10 A	ND	ND	2.1 AP	6.2 AP	1.1 AP	1.7 AP	ND	ND	ND	ND	NF	NF	NF	NF
		29 lb/A & 5 A	ND	ND	4.3 AP	12 AP	2.3 AP	3.5 AP	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Gravity Feed Backpack Spreader	29 lb/A & 10 A	ND	ND	0.11	0.17	0.03	0.033	ND	ND	ND	ND	NF	NF	NF	NF
		29 lb/A & 5 A	ND	ND	0.22	0.35	0.059	0.065	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Scoop and Bucket	29 lb/A & 10 A	ND	ND	0.048	0.057	0.0097	0.01	ND	ND	ND	ND	NF	NF	NF	NF
		29 lb/A & 5 A	ND	ND	0.097	0.11	0.019	0.02	ND	ND	ND	ND	NF	NF	NF	NF
Field Grown Flowers & Groundcover (lower rate)	Loading granular formulations for ground application	11 lb/A & 40 A	2.9	1.1	3.1	7.4	1.3	1.8	3.6	11	2	3.3	NF	150	NF	57
	Applying granules with tractor-drawn spreader		3.4	1.1	3.9	8.1	1.4	1.7	4.5	12	2.1	2.9	5.2	18	3.1	5.3

TABLE 3: SUMMARY OF HANDLER RISKS FOR DISULFOTON BY CROP continued

Crop	Handler Scenario	Application Rate / Area Treated [a,b]	Baseline Total MOE[c] (UF=100)		PPE (Gloves) Total MOE[c] (UF=100)				PPE (Gloves + Double Layers) Total MOE[c] (UF=100)				Engineering Controls Total MOE[c] (UF=100)			
			Short-T	Inter.-T	Short-T		Inter.-T		Short-T		Inter.-T		Short-T		Inter.-T	
					No R	Resp	No R	Resp	No R	Resp	No R	Resp	No I	Inh	No I	Inh
	Loading/Applying with Push Type Spreader	11 lb/A & 5 A	1.5	0.29	2.1	2.7	0.45	0.48	3.3	5	0.86	0.94	NF	NF	NF	NF
	Loading/Applying with Bellygrinder	11 lb/A & 1 A	0.3	0.052	0.32	0.34	0.056	0.057	0.5	0.55	0.091	0.093	NF	NF	NF	NF
	Loading/Applying with Pump Feed Backpack Spreader	11 lb/A & 10 A	ND	ND	5.6 AP	16 AP	3 AP	4.6 AP	ND	ND	ND	ND	NF	NF	NF	NF
		11 lb/A & 5 A	ND	ND	11 AP	33 AP	6 AP	9.2 AP	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Gravity Feed Backpack Spreader	11 lb/A & 10 A	ND	ND	0.29	0.46	0.078	0.086	ND	ND	ND	ND	NF	NF	NF	NF
		11 lb/A & 5 A	ND	ND	0.58	0.91	0.16	0.17	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Scoop and Bucket	11 lb/A & 10 A	ND	ND	0.13	0.15	0.025	0.026	ND	ND	ND	ND	NF	NF	NF	NF
		11 lb/A & 5 A	ND	ND	0.25	0.3	0.051	0.053	ND	ND	ND	ND	NF	NF	NF	NF
Field Grown Ornamental Trees & Shrubs (Injection)	Loading granular formulations for ground application	11 lb/A & 40 A	2.9	1.1	3.1	7.4	1.3	1.8	3.6	11	2	3.3	NF	150	NF	57
	Applying granules with tractor-drawn spreader		3.4	1.1	3.9	8.1	1.4	1.7	4.5	12	2.1	2.9	5.2	18	3.1	5.3
	Loading/Applying with Push Type Spreader	11 lb/A & 5 A	1.5	0.29	2.1	2.7	0.45	0.48	3.3	5	0.86	0.94	NF	NF	NF	NF
	Loading/Applying with Bellygrinder	11 lb/A & 1 A	0.3	0.052	0.32	0.34	0.056	0.057	0.5	0.55	0.091	0.093	NF	NF	NF	NF
	Loading/Applying with Pump Feed Backpack Spreader	11 lb/A & 10 A	ND	ND	5.6 AP	16 AP	3 AP	4.6 AP	ND	ND	ND	ND	NF	NF	NF	NF
		11 lb/A & 5 A	ND	ND	11 AP	33 AP	6 AP	9.2 AP	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Gravity Feed Backpack Spreader	11 lb/A & 10 A	ND	ND	0.29	0.46	0.078	0.086	ND	ND	ND	ND	NF	NF	NF	NF
		11 lb/A & 5 A	ND	ND	0.58	0.91	0.16	0.17	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Scoop and Bucket	11 lb/A & 10 A	ND	ND	0.13	0.15	0.025	0.026	ND	ND	ND	ND	NF	NF	NF	NF
		11 lb/A & 5 A	ND	ND	0.25	0.3	0.051	0.053	ND	ND	ND	ND	NF	NF	NF	NF
Potted Ornamentals	Loading/Applying with Pump Feed Backpack Spreader	0.2 lb ai/day	ND	ND	3100 AP	9100 AP	1600 AP	2500 AP	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Gravity Feed Backpack Spreader		ND	ND	160	250	43	47	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Scoop and Bucket		ND	ND	70	83	14	14	ND	ND	ND	ND	NF	NF	NF	NF
Chrismas Trees	Loading granular formulations for ground application	78 lb/A & 50 A	0.33	0.13	0.35	0.84	0.15	0.2	0.4	1.3	0.23	0.37	NF	16	NF	6.4
	Applying granules with tractor-drawn spreader		0.39	0.12	0.44	0.91	0.16	0.2	0.51	1.3	0.23	0.32	0.58	2	0.35	0.6

TABLE 3: SUMMARY OF HANDLER RISKS FOR DISULFOTON BY CROP continued

Crop	Handler Scenario	Application Rate / Area Treated [a,b]	Baseline Total MOE[c] (UF=100)		PPE (Gloves) Total MOE[c] (UF=100)				PPE (Gloves + Double Layers) Total MOE[c] (UF=100)				Engineering Controls Total MOE[c] (UF=100)			
			Short-T	Inter.-T	Short-T		Inter.-T		Short-T		Inter.-T		Short-T		Inter.-T	
					No R	Resp	No R	Resp	No R	Resp	No R	Resp	No I	Inh	No I	Inh
	Loading/Applying with Push Type Spreader	78 lb/A & 5 A	0.21	0.041	0.3	0.38	0.064	0.067	0.46	0.71	0.12	0.13	NF	NF	NF	NF
	Loading/Applying with Bellygrinder	78 lb/A & 1 A	0.042	0.0074	0.045	0.048	0.0079	0.008	0.07	0.077	0.013	0.013	NF	NF	NF	NF
	Loading/Applying with Pump Feed Backpack Spreader	78 lb/A & 10 A	ND	ND	0.79 AP	2.3 AP	0.42 AP	0.65 AP	ND	ND	ND	ND	NF	NF	NF	NF
		78 lb/A & 5 A	ND	ND	1.6 AP	4.6 AP	0.84 AP	1.3 AP	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Gravity Feed Backpack Spreader	78 lb/A & 10 A	ND	ND	0.041	0.064	0.011	0.012	ND	ND	ND	ND	NF	NF	NF	NF
		78 lb/A & 5 A	ND	ND	0.082	0.13	0.022	0.024	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Scoop and Bucket	78 lb/A & 10 A	ND	ND	0.018	0.021	0.0036	0.0037	ND	ND	ND	ND	NF	NF	NF	NF
		78 lb/A & 5 A	ND	ND	0.036	0.043	0.0072	0.0074	ND	ND	ND	ND	NF	NF	NF	NF
Christmas Trees (SLN)	Loading granular formulations for ground application	4.5 lb/A & 50 A	5.7	2.2	6	15	2.6	3.4	7	22	4	6.4	NF	280	NF	110
	Applying granules with tractor-drawn spreader		6.7	2.1	7.6	16	2.8	3.4	8.9	23	4	5.6	10	34	6	10
	Loading/Applying with Push Type Spreader	4.5 lb/A & 5 A	3.6	0.71	5.1	6.6	1.1	1.2	8	12	2.1	2.3	NF	NF	NF	NF
	Loading/Applying with Bellygrinder	4.5 lb/A & 1 A	0.73	0.13	0.78	0.82	0.14	0.14	1.2	1.3	0.22	0.23	NF	NF	NF	NF
	Loading/Applying with Pump Feed Backpack Spreader	4.5 lb/A & 10 A	ND	ND	14 AP	40 AP	7.3 AP	11 AP	ND	ND	ND	ND	NF	NF	NF	NF
		4.5 lb/A & 5 A	ND	ND	27 AP	80 AP	15 AP	22 AP	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Gravity Feed Backpack Spreader	4.5 lb/A & 10 A	ND	ND	0.71	1.1	0.19	0.21	ND	ND	ND	ND	NF	NF	NF	NF
		4.5 lb/A & 5 A	ND	ND	1.4	2.2	0.38	0.42	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Scoop and Bucket	4.5 lb/A & 10 A	ND	ND	0.31	0.37	0.062	0.064	ND	ND	ND	ND	NF	NF	NF	NF
		4.5 lb/A & 5 A	ND	ND	0.62	0.74	0.12	0.13	ND	ND	ND	ND	NF	NF	NF	NF
Coffee Trees	Loading granular formulations for ground application	8.3 lb/A & 80 A	1.9	0.76	2	4.9	0.87	1.2	2.4	7.3	1.3	2.2	NF	96	NF	38
	Applying granules with tractor-drawn spreader		2.3	0.72	2.6	5.3	0.93	1.1	3	7.7	1.4	1.9	3.4	12	2	3.5
	Loading/Applying with Pump Feed Backpack Spreader	8.3 lb/A & 10 A	ND	ND	7.4 AP	22 AP	4 AP	6.1 AP	ND	ND	ND	ND	NF	NF	NF	NF
		8..3 lb/A & 5 A	ND	ND	15 AP	44 AP	7.9 AP	12 AP	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Gravity Feed Backpack Spreader	8.3 lb/A & 10 A	ND	ND	0.39	0.6	0.1	0.11	ND	ND	ND	ND	NF	NF	NF	NF
		8.3 lb/A & 5 A	ND	ND	0.77	1.2	0.21	0.23	ND	ND	ND	ND	NF	NF	NF	NF
	Loading/Applying with Scoop and Bucket	8.3 lb/A & 10 A	ND	ND	0.17	0.2	0.034	0.035	ND	ND	ND	ND	NF	NF	NF	NF

TABLE 3: SUMMARY OF HANDLER RISKS FOR DISULFOTON BY CROP continued

Crop	Handler Scenario	Application Rate / Area Treated [a,b]	Baseline Total MOE[c] (UF=100)		PPE (Gloves) Total MOE[c] (UF=100)				PPE (Gloves + Double Layers) Total MOE[c] (UF=100)				Engineering Controls Total MOE[c] (UF=100)			
			Short-T	Inter.-T	Short-T		Inter.-T		Short-T		Inter.-T		Short-T		Inter.-T	
					No R	Resp	No R	Resp	No R	Resp	No R	Resp	No I	Inh	No I	Inh
		8.3 lb/A & 5 A	ND	ND	0.34	0.4	0.067	0.07	ND	ND	ND	ND	NF	NF	NF	NF

Note:

Short-T indicates short-term exposure and risk
Inter-T indicates intermediate-term exposure and risk
No R indicates no respirator
Resp indicates use of a dust/mist respirator
No I indicates no inhalation protection was provided by the engineering control
Inh indicates that inhalation protection was provided by the engineering control
AP indicates that an apron was worn on the backs of applicators.
ND indicates no data – an exposure scenario was identified, but there are no acceptable data to complete assessment.
NF indicates that no engineering controls are feasible for this exposure scenario.
NG indicates no gloves were added for this scenario.
N/A indicates that the personal protective equipment are not applicable or not appropriate for this scenario.

Footnotes:

a Application rates are based on maximum values found on various labels or proposed by registrant. In most scenarios, a range of maximum application rates is used to represent the range of rates for different crops/sites/uses. Most application rates upon which the analysis is based are presented as lb ai/A. In the case of ornamentals in pots, the application rate is presented as lb ai/day). Specific application rates and the corresponding EPA Reg. numbers that are intended as examples of each exposure assessment scenario are presented below:

4.0 lb/A EC formulations:	tobacco (Reg #3125-307)
3.0 lb/A EC formulations:	potatoes: foliar OR, WA, ID UT (Reg #3125-307); potatoes: soil (Reg #3125-307); poplars grown for pulpwood (Reg #3125-307--OR-910027)
2.5 lb/A EC formulations:	peas and lentils (Reg #3125-307)
2.0 lb/A EC formulations:	beans: dry, snap, lima (Reg #3125-307); cabbage (Reg #3125-307); lettuce (Reg #3125-307); peppers (Reg #3125-307); radish grown for seed (Reg #3125-307-WA-920026);
1.0 lb/A EC formulations:	asparagus (SLN) (Reg #3125-307-CA-840192); barley (Reg #3125-307); broccoli (Reg #3125-307); Brussels sprouts (Reg #3125-307); cauliflower (Reg #3125-307); cotton (Reg #3125-307); sorghum (Reg #3125-307); wheat (Reg #3125-307);
0.75 lb/A EC formulations:	wheat (Reg #3125-307)
0.5 lb/A EC formulations:	sorghum (Reg #3125-307); potatoes: foliar (Reg #3125-307)
0.2 lb/A EC formulations:	cotton ((Reg #3125-307- TX-860007)
109 lb/A Granular formulations:	field-grown ornamental shrubs (Reg #3125-172) based on the assumption that the shrubs are two feet tall and occupy two square feet (i.e., roses);
78 lb/A Granular formulations:	Christmas trees (Reg #3125-172) based on the assumption that the trunk is 2 inches in diameter and are planted 1700 trees per acre;
37 lb/A Granular formulations:	field-grown ornamental trees (Reg #3125-172) based on the assumption that the trunk is 2 inches in diameters and are planted 800 trees per acre;
29 lb/A Granular formulations:	field-grown flowers and groundcover (Reg #3125-72)
11 lb/A Granular formulations:	field-grown ornamental trees and shrubs: injection (Reg #3125-172) and field-grown flowers and groundcover (Reg #3125-72)
8.3 lb/A Granular formulations:	coffee trees (Reg #3125-172) based on the assumption that the trees are 8 feet tall and are planted 435 trees per acre
4.5 lb/A Granular formulations:	Christmas trees ((Reg #3125-172-NC-880001)
4.0 lb/A Granular formulations:	tobacco (Reg #3125-172);
3.0 lb/A Granular formulations:	potatoes: soil (Reg #3125-172);
2.5 lb/A Granular formulations:	peas and lentils (Reg #3125-172);
2.0 lb/A Granular formulations:	peanuts (Reg #3125-172-NC-920011); peppers (Reg #3125-172); radish grown for seed ((Reg #3125-172-WA-920027);
1.5 lb/A Granular formulations:	cabbage (Reg #3125-172);
1.0 lb/A Granular formulations:	barley (Reg #3125-172); beans: dry, snap, lima: (Reg #3125-172); broccoli (Reg #3125-172); Brussels sprouts (Reg #3125-172); cauliflower

TABLE 3: SUMMARY OF HANDLER RISKS FOR DISULFOTON BY CROP continued

(Reg #3125-172); clover grown for seed (Reg #3125-172-WA-980004); cotton (Reg #3125-172); peanuts (Reg #3125-172); sorghum (Reg #3125-172); soybeans (Reg #3125-172); wheat (Reg #3125-172);

0.2 lb/day Granular formulations:potted ornamentals (Reg #3125-172); based on the assumption that 350 pots that are 12 inches in diameter are treated each day;

b Amount handled per day values are based on HED Exposure SAC Policy # 009 "Standard Values for Daily Acres Treated in Agriculture," revised June 23, 2000, or best professional judgment when data is not available.

Summary of Concerns for Occupational Handlers, Data Gaps, and Confidence in Exposure and Risk Estimates

EPA established an uncertainty factor of 100 for dermal and inhalation risks. Margins of exposure (MOEs) less than 100 are of concern to the Agency. Both short- and intermediate-term risks are assessed for occupational handlers. Since the short-term dermal endpoint is based on a 3-day dermal study, EPA believes that intermediate-term risks are triggered for most handler scenarios, particularly by commercial (for-hire) applicators.

Occupational Handler Scenarios with Risk Concerns

The results of the risk assessment for occupational handlers indicates that total short-term risks are of concern at maximum feasible mitigation through personal protective equipment or engineering controls, as applicable, for:

- mixing/loading *liquid* formulations for all crops and scenarios;
- loading *granular* formulations for all aerial application scenarios, except applications to clover grown for seed;
- loading *granular* formulations for all ground application scenarios where the application rate is greater than 16.5 pounds active ingredient per acre and application is to 40 acres per day and where the application is greater than 8.3 pounds per acre and application is to 80 acres per day;
- applying sprays or granules aerially;
- applying sprays with groundboom equipment, except applications where the application rate is 0.5 pounds active ingredient per acre and application is to 80 acres per day;
- applying granules with tractor-drawn spreaders;
- loading/applying with a push type granular spreader for all crops and scenarios;
- loading/applying with a bellygrinder granular spreader for all crops and scenarios;
- loading/applying with a pump-feed backpack granular spreader for all crops and scenarios, except applications to potted ornamentals;
- loading/applying with a gravity-feed backpack granular spreader for all crops and scenarios, except applications to potted ornamentals;
- loading/applying granular formulation with a scoop and bucket for all crops and scenarios;
- flagging for aerial applications *only* when flagging to support aerial spray applications for applications at 4 pounds active ingredient per acre and application is to 350 acres per day.

The results of the risk assessment for occupational handlers indicates that total intermediate-term risks are of concern at maximum feasible mitigation through personal protective equipment or engineering controls, as applicable, for:

- mixing/loading *liquid* formulations for all crops and scenarios;
- loading *granular* formulations for all aerial application scenarios, except where the application rate is 1 pound active ingredient per acre and application is to 350 acres per day;

- loading *granular* formulations for all ground application scenarios where the application rate is greater than 4.5 pounds active ingredient per acre and application is to 50 acres per day and where the application is greater than 3 pounds per acre when application is to 80 acres per day;
- applying sprays or granular aerially;
- applying sprays with groundboom equipment;
- applying granules with tractor-drawn spreaders;
- loading/applying with a push type granular spreader for all crops and scenarios;
- loading/applying with a bellygrinder granular spreader for all crops and scenarios;
- loading/applying with a pump-feed backpack granular spreader for all crops and scenarios; except applications to potted ornamentals;
- loading/applying with a gravity-feed backpack granular spreader for all crops and scenarios;
- loading/applying granular formulation with a scoop and bucket for all crops and scenarios;
- flagging to support aerial spray applications, except where the application rate is 0.5 pound active ingredient per acre and application is to 350 acres per day;
- flagging to support aerial granular applications, where the application rate is greater than 2.5 pounds active ingredient per acre and application is to 350 acres per day *and* where the application is greater than 0.5 pounds per acre when application is to 1200 acres per day;

Data Quality and Confidence in Assessment

Several issues must be considered when interpreting the occupational exposure risk assessment. Confidence in the exposure data is also listed in Appendix 6, as low (L), medium (M) or high (H). These include:

- Several handler assessments were completed using “low quality” PHED data due to the lack of a more acceptable data set.
- Several generic protection factors were used to calculate handler exposures. These protection factors have not been completely evaluated and accepted by HED.
- Factors used to calculate daily exposures to handlers (e.g., acres treated per day and potted plants treated per day) are based on the best professional judgement, due to a lack of pertinent use data.

Post-Application Exposures and Risks

Occupational Postapplication Exposure Scenarios, Data, and Assumptions

HED has determined that there are potential postapplication occupational exposures to individuals entering treated areas:

- following foliar applications for the purpose of weeding, irrigating, scouting and other non-harvesting activities associated with low-growing or immature field crops;

- following soil-directed applications for the purpose of weeding, irrigating, scouting, transplanting, harvesting, and pruning of various food, feed, fiber, forestry, and ornamental crops.

Data Source Descriptions for Occupational Scenarios Considered

Chemical-specific postapplication exposure data following foliar applications to potatoes have been submitted in support of the reregistration of disulfoton, however HED has found these studies to be unacceptable.[10] In addition to the other concerns about the disulfoton-specific postapplication study, the Agency found no indication that known disulfoton toxic degradates (i.e., disulfoton sulfoxide, disulfoton sulfone, D-oxygen analog sulfoxide, and D-oxygen analog sulfone) had been considered in assessing the residues. In lieu of acceptable disulfoton-specific data, a surrogate rangefinder postapplication exposure assessment was conducted to determine potential occupational postapplication risks from disulfoton. Since EPA believes that the applicable postapplication tasks for the crops with foliar-directed applications are likely to be of short-term duration (i.e., 1 to 7 days), the short-term dermal endpoint of 0.5 mg/kg/day was used to assess postapplication risks following foliar applications of disulfoton. An intermediate-term dermal endpoint of 0.03 mg/kg/day (with a 36 percent dermal absorption value) is also available for disulfoton and would likely be the appropriate endpoint to assess some postapplication risks following soil-directed applications of disulfoton to some food, feed, fiber, and ornamental crops. However, post-application risks following soil-directed applications of disulfoton cannot be evaluated at this time.

Occupational Postapplication Exposure and Risk Estimates

Foliar applications: For postapplication exposures following applications of disulfoton to foliage, EPA roughly estimated the exposures and risks to postapplication workers and handlers (scouts) using an assumption that 20 percent of the initial application remained as a dislodgeable residue on foliar surfaces immediately following application and the residue degraded into nontoxic by-products at a rate of 10 percent per day. Transfer coefficients and activities are derived from the Science Advisory Council for Exposure: Policy Memo #003.1 "Agricultural Transfer Coefficients," May 7, 1998 and revised August 7, 2000. The equations used for the calculations are presented below.

Dislodgeable foliar residues (DFRs) were calculated as follows:

$$DFR\left(\frac{\mu g}{cm^2}\right) = AR\left(\frac{lb\ ai}{A}\right)\ x\ CF\left(\frac{\mu g/cm^2}{lb\ ai/A}\right)\ x\ F\ x\ (1 - DR)^t$$

Where:

AR = Application rate
CF = Conversion factor (11.2 ug per cm^2 per lb ai per acre)
F = Fraction retained on foliage (20 percent)
DO = Daily dissipation rate (10 percent per day)
t = Days after treatment

Daily Dermal Doses were calculated as follows:

$$Dose\ (mg/kg/d) = \frac{(DFR\ (\mu g/cm^2)\ x\ Tc\ (cm^2/hr)\ x\ CF\left(\frac{1\ mg}{1{,}000\ \mu g}\right)\ x\ ED\ (hrs/day))}{BW\ (kg)}$$

Where:

DFR = Dislodgeable foliar residue (μg/cm^2)
Tc = Transfer coefficient for the activity of concern;
CF = Conversion factor (i.e., 1 mg/1,000 μg)
ED = Exposure duration; 8 hours worked per day
BW = body weight (70 kg)

MOEs were calculated as follows:

$$MOE = \frac{NOEL\ (mg/kg/day)}{Dose\ (mg/kg/day)}$$

Where:

NOAEL = 0.5 mg/kg/day
Dose = calculated daily dermal dose

Soil-Directed applications: At this time, EPA has no chemical-specific or surrogate data on which to base a postapplication exposure and risk assessment following soil-directed applications of disulfoton. EPA is aware that disulfoton degrades under some conditions to byproducts (i.e., (i.e., disulfoton sulfoxide, disulfoton sulfone, D-oxygen analog sulfoxide, and D-oxygen analog sulfone) that may be equally toxic as the parent disulfoton. However, the percent of the parent that degrades to the toxic byproducts is not known nor does EPA know the rate at which the toxic degradates will breakdown to nontoxic byproducts. EPA is aware that disulfoton residues may persist in soils for relatively long periods following application, but no specific data indicating the degradation curve is available. For these reasons, the Agency is

concerned about exposures by workers and handlers (scouts) to disulfoton residues in the soil, particularly when applications rates for some crops and scenarios range to more than 100 pounds active ingredient per acre. EPA believes that contact with treated soil could result in risks of concern to postapplication workers and handlers (scouts). To facilitate the assessment of risks postapplication workers following soil-directed applications of disulfoton, additional data would be necessary.

Summary of Postapplication Risks

Foliar applications: The uncertainty factor for postapplication risks to disulfoton is 100; . therefore, an MOE of 100 or greater is considered not a concern. Based on the rough estimate of postapplication exposures and risks, assumptions, Table 4 summarizes the occupational postapplication risks following foliar applications of disulfoton. The MOEs are of concern at day one (i.e., 24 hours) for all crops, except for foliar applications to cotton at an application rate of 0.2 pounds active ingredient per acre. For the remaining crops, the postapplication day when risks are no longer a concern range from day 13 following application to more than day 30 following application, depending on the application rate, the timing of application, and the applicable activity.

Table 4: Summary of Occupational PostApplication Risks Following Foliar Applications of Disulfoton

Crop	Application Rate	Tasks of Concern[1]	Timing of Application	Transfer Coefficient[1]	Day After Treatment	Dislodgeable Foliar Residue[2]	Dose[3]	MOE[4] (UF= 100)
Asparagus	1.0	Irrigating, scouting, thinning, weeding immature or low foliage plants	fern stage (3 per year; 120 DTH)	300	1	2.019	0.0692	6.5
					26	0.145	0.0050	101
Barley	1.0		after tillering (30 DTH)	100	1	2.019	0.0231	20
					16	0.416	0.0048	105
Cotton (SLN)	0.2		Before boll opens (30 DTH)	100	1	0.404	0.0046	108
Potatoes (East of Rockies)	0.5		When pest appears (3 per season; 30 DTH)	300	1	1.010	0.0346	14
					20	0.136	0.0047	107
Potatoes (OR, ID, UT, WA only)	3.0		As needed (1 per season; 60 DTH)	300	1	6.058	0.2077	2.4
					30	0.285	0.0098	51
Sorghum	0.5	scouting, irrigation, weeding mature or full foliage plants	As needed (2 per season; 7 DTH)	1000	1	1.01	0.1154	4.3
					30	0.048	0.0054	92
Wheat	0.75	Irrigating, scouting, thinning, weeding immature or low foliage plants	Post-plant (after tillering; 30 DTH)	100	1	1.515	0.0173	29
					13	0.428	0.0049	102
Wheat (SLN)	1.0		Two per season (30 DTH)	100	1	2.019	0.0231	20
					16	0.416	0.0048	105

Footnotes:

1 Transfer coefficient and activities from Science Advisory Council for Exposure: Policy Memo #003.1 "Agricultural Transfer Coefficients," May 7, 1998 and revised August 7, 2000.

2 Dislodgeable foliar residue ($\mu g/cm^2$) is based on the assumption that 20 percent of the application rate is on the foliar surface at day 0 and the active ingredient (including any toxic degradates) degrades at a rate of 10 percent per day.

3 Absorbed dermal dose (mg/kg/day) is the dislodgeable foliar residue ($\mu g/cm^2$) x transfer coefficient (cm^2/hr) x conversion factor (1 mg/1,000 μg) x exposure time (8 hrs) x dermal absorption (100%) / body weight(70 kg).

4 Margin of Exposure (MOE) is short-term dermal NOAEL (0.5 mg/kg/day) / absorbed dermal dose (mg/kg/day).

References

1) Becker, J. (2000) Revised Occupational and Residential Exposure Assessment and Recommendations for the Reregistration Eligibility Decision Document for Disulfoton. Washington, D.C.: U.S. Environmental Protection Agency, Office of Pesticide Programs. February 7, 2000.

2) Becker, J. (2000) Amendment to the the Disulfoton Occupational and Residential Exposure and Risk Assessment. Washington, D.C.: U.S. Environmental Protection Agency, Office of Pesticide Programs. August 24, 2000.

3) U.S. EPA (2001) Disulfoton: Revised (3rd) Report of Hazard Identification Assessment Review Committee. April 10, 2001.

4) Disulfoton Labels.

5) U.S. EPA (1998) Disulfoton LUIS Table for Exposure Assessors (PRD report dated 11/06/96 and report run date 02/04/98).

6) U.S. EPA (1998) PHED Surrogate Exposure Guide, Version 1.1. Washington, D.C.: U.S. Environmental Protection Agency, Office of Pesticide Programs. August 1998.

7) Bangs, G. (2001) Summary of HED's Reviews of Outdoor Residential Exposure Task Force (ORETF) Chemical Handler Exposure Studies; MRID 449722-01. Memorandum from Gary Bangs (HED) to Demson Fuller (Special Review and Reregistration Division), April 30, 2001.

8) Dawson, J. (2001) Aldicarb. Review of aldicarb (Temik 10G) granular backpack mixer/loader/applicator study (MRID 451672-01) in bananas as a source of surrogate data for ethoprop exposure and assessment. Washington, D.C.: U.S. Environmental Protection Agency, Office of Pesticide Programs. October 17, 2000.

9) Dawson, J. (2001) Ethoprop. Review of fipronil granular mixer/loader/applicator study (MRID 452507-01) in bananas as a source of surrogate data and accompanying ethoprop risk assessment. Washington, D.C.: U.S. Environmental Protection Agency, Office of Pesticide Programs. January 5, 2001.

10) Versar, Inc. 1999. Review of the DFR Study - Dissipation of Dislodgeable Foliar Disulfoton Residues from Di-Syston® 8 Treated Potatoes (MRID No. 446880-01). January 4, 1999.

11) U.S. EPA (2001) Recommended Revisions to the Standard Operating Procedures (SOPs) for Residential Exposure Assessments, Science Advisory Council for Exposure Policy No. 12. Washington, D.C.: U.S. Environmental Protection Agency, Office of Pesticide Programs. February 22, 2001.

cc: RRB2 Files

APPENDIX

HANDLER EXPOSURE AND RISK SUMMARY TABLES
FOR
REVISED OCCUPATIONAL EXPOSURE ASSESSMENT
FOR
THE REREGISTRATION ELIGIBILITY DECISION DOCUMENT
FOR
DISULFOTON

Table 1: Occupational Handler Short- and Intermediate-Term Exposures and Risks at Baseline Attire

Exposure Scenario	Crop Type	Application Rate[a]	Amount Handled[b] (acres unless specified)	Baseline Dermal Unit Exposure (mg/lb ai)[c]	Baseline Inhalation Unit Exposure (ug/lb ai)[d]	Short-Term Baseline Dermal Dose[e]	Intermediate-Term Baseline Dermal Dose[f]	Baseline Short-Term Dermal MOE[g]	Baseline Intermediate-Term Dermal MOE[h]	Baseline Inhalation Dose[i]	Baseline Inhalation MOE[j]	Baseline Short-Term Dermal + Inhalation MOE[k]	Baseline Intermediate-Term Dermal + Inhalation MOE[k]
MIXER/LOADER													
Mixing/Loading Liquid Formulations for Aerial Application (1a)	tobacco	4	350	2.9	1.2	58	21	0.0086	0.0014	0.024	1.9	0.0086	0.0014
	asparagus (SLN)	1	350			15	5.2	0.034	0.0057	0.006	7.5	0.034	0.0057
	barley	1	1200			50	18	0.01	0.0017	0.021	2.2	0.01	0.0017
	wheat	0.75	1200			37	13	0.013	0.0022	0.015	2.9	0.013	0.0022
	sorghum	0.5	1200			25	8.9	0.02	0.0034	0.01	4.4	0.02	0.0033
	potatoes (foliar)	0.5	350			7.3	2.6	0.069	0.011	0.003	15	0.069	0.011
	cotton (SLN)	0.2	1200			9.9	3.6	0.05	0.0084	0.0041	11	0.05	0.0084
Mixing/Loading Liquid Formulations for Chemigation Application (1b)	potatoes (foliar) - OR, WA, ID, UT	3	350			44	16	0.011	0.0019	0.018	2.5	0.011	0.0019
	poplars grown for pulpwood (SLN)	3	350			44	16	0.011	0.0019	0.018	2.5	0.011	0.0019
	cabbage, lettuce	2	350			29	10	0.017	0.0029	0.012	3.8	0.017	0.0029
	broccoli, brussels sprouts, cauliflower, cotton	1	350			15	5.2	0.034	0.0057	0.006	7.5	0.034	0.0057
Mixing/Loading Liquid Formulations for Groundboom Application (1c)	tobacco	4	80			13	4.8	0.038	0.0063	0.0055	8.2	0.038	0.0063
	poplars grown for pulpwood (SLN)	3	80			9.9	3.6	0.05	0.0084	0.0041	11	0.05	0.0084
	potatoes (soil)	3	80			9.9	3.6	0.05	0.0084	0.0041	11	0.05	0.0084
	peas, lentils	2.5	80			8.3	3	0.06	0.01	0.0034	13	0.06	0.01
	beans(dry, snap, lima), lettuce, peppers, radish grown for seed, cabbage	2	80			6.6	2.4	0.075	0.013	0.0027	16	0.075	0.013
	wheat, barley, cotton, sorghum	1	200			8.3	3	0.06	0.01	0.0034	13	0.06	0.01
	asparagus (SLN), broccoli, brussels sprouts, cauliflower	1	80			3.3	1.2	0.15	0.025	0.0014	33	0.15	0.025
	potatoes (foliar)	0.5	80			1.7	0.6	0.3	0.05	0.00069	66	0.3	0.05
Loading Granular Formulations for Aerial Application (2a)	tobacco	4	350	0.0084	1.7	0.17	0.06	3	0.5	0.034	1.3	0.92	0.36
	potatoes (soil)	3	350			0.13	0.045	4	0.66	0.026	1.8	1.2	0.48
	peas, lentils	2.5	350			0.11	0.038	4.8	0.79	0.021	2.1	1.5	0.58
	peanuts (SLN)	2	350			0.084	0.03	6	0.99	0.017	2.6	1.8	0.72
	clover grown for seed (SLN)	1	350			0.042	0.015	12	2	0.0085	5.3	3.7	1.4

Table 1: Occupational Handler Short- and Intermediate-Term Exposures and Risks at Baseline Attire continued

Exposure Scenario	Crop Type	Application Rate[a]	Amount Handled[b] (acres unless specified)	Baseline Dermal Unit Exposure (mg/lb ai)[c]	Baseline Inhalation Unit Exposure (ug/lb ai)[d]	Short-Term Baseline Dermal Dose[e]	Intermediate-Term Baseline Dermal Dose[f]	Baseline Short-Term Dermal MOE[g]	Baseline Intermediate-Term Dermal MOE[h]	Baseline Inhalation Dose[i]	Baseline Inhalation MOE[j]	Baseline Short-Term Dermal + Inhalation MOE[k]	Baseline Intermediate-Term Dermal + Inhalation MOE[k]
	barley, sorghum, wheat	1	1200			0.14	0.052	3.5	0.58	0.029	1.5	1.1	0.42
Loading Granular Formulations for Ground Application (2b)	field-grown ornamental shrubs	109	40			0.52	0.19	0.96	0.16	0.11	0.42	0.29	0.12
	field-grown ornamental trees	37	40			0.18	0.064	2.8	0.47	0.036	1.3	0.87	0.34
	field-grown flowers & groundcover	29	40			0.14	0.05	3.6	0.6	0.028	1.6	1.1	0.44
	field-grown ornamental trees and shrubs (inject) and flowers & groundcover	11	40			0.053	0.019	9.5	1.6	0.011	4.2	2.9	1.1
	coffee trees	8.3	80			0.08	0.029	6.3	1	0.016	2.8	1.9	0.76
	Christmas trees	78	50			0.47	0.17	1.1	0.18	0.095	0.48	0.33	0.13
	Christmas trees (SLN)	4.5	50			0.027	0.0097	19	3.1	0.0055	8.2	5.7	2.2
	tobacco	4	80			0.038	0.014	13	2.2	0.0078	5.8	4	1.6
	potatoes (soil)	3	80			0.029	0.01	17	2.9	0.0058	7.7	5.3	2.1
	peas, lentils	2.5	80			0.024	0.0086	21	3.5	0.0049	9.3	6.4	2.5
	peppers, peanuts (SLN), radish grown for seed (SLN)	2	80			0.019	0.0069	26	4.3	0.0039	12	8	3.2
	cabbage	1.5	80			0.014	0.0052	35	5.8	0.0029	15	11	4.2
	barley, cotton, sorghum, soybeans, wheat	1	200			0.024	0.0086	21	3.5	0.0049	9.3	6.4	2.5
	peanuts, beans (dry, snap, lima), brussels sprout, cauliflower, broccoli, clover grown for seed (SLN)	1	80			0.0096	0.0035	52	8.7	0.0019	23	16	6.3
APPLICATOR													
Applying Sprays with an Airplane (3)	tobacco	4	350	No Data See Engineering Controls									
	asparagus (SLN)	1	350										
	barley	1	1200										
	wheat	0.75	1200										
	sorghum	0.5	1200										
	potatoes (foliar)	0.5	350										

Table 1: Occupational Handler Short- and Intermediate-Term Exposures and Risks at Baseline Attire continued

Exposure Scenario	Crop Type	Application Rate[a]	Amount Handled[b] (acres unless specified)	Baseline Dermal Unit Exposure (mg/lb ai)[c]	Baseline Inhalation Unit Exposure (ug/lb ai)[d]	Short-Term Baseline Dermal Dose[e]	Intermediate-Term Baseline Dermal Dose[f]	Baseline Short-Term Dermal MOE[g]	Baseline Intermediate-Term Dermal MOE[h]	Baseline Inhalation Dose[i]	Baseline Inhalation MOE[j]	Baseline Short-Term Dermal + Inhalation MOE[k]	Baseline Intermediate-Term Dermal + Inhalation MOE[k]
	cotton (SLN)	0.2	1200										
Applying Granulars with an Airplane (4)	tobacco	4	350	No Data See Engineering Controls									
	potatoes (soil)	3	350										
	peas, lentils	2.5	350										
	peanuts (SLN)	2	350										
	barley, sorghum, wheat	1	1200										
	clover grown for seed (SLN)	1	350										
Applying with a Groundboom (5)	tobacco	4	80	0.014	0.74	0.064	0.023	7.8	1.3	0.0034	13	4.9	1.2
	poplars grown for pulpwood (SLN)	3	80			0.048	0.017	10	1.7	0.0025	18	6.6	1.6
	potatoes (soil)	3	80			0.048	0.017	10	1.7	0.0025	18	6.6	1.6
	peas, lentils	2.5	80			0.04	0.014	13	2.1	0.0021	21	7.9	1.9
	beans(dry, snap, lima), lettuce, peppers, radish grown for seed, cabbage	2	80			0.032	0.012	16	2.6	0.0017	27	9.8	2.4
	wheat, barley, cotton, sorghum	1	200			0.04	0.014	13	2.1	0.0021	21	7.9	1.9
	asparagus (SLN), broccoli, brussels sprouts, cauliflower	1	80			0.016	0.0058	31	5.2	0.00085	53	20	4.7
	potatoes (foliar)	0.5	80			0.008	0.0029	63	10	0.00042	110	39	9.5
Applying Granulars with a Tractor Drawn Spreader (6)	field-grown ornamental shrubs	109	40	0.0099	1.2	0.62	0.22	0.81	0.14	0.075	0.6	0.35	0.11
	field-grown ornamental trees	37	40			0.21	0.075	2.4	0.4	0.025	1.8	1	0.33
	field-grown flowers & groundcover	29	40			0.16	0.059	3	0.51	0.02	2.3	1.3	0.41
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	40			0.062	0.022	8	1.3	0.0075	6	3.4	1.1
	coffee trees	8.3	80			0.094	0.034	5.3	0.89	0.011	4	2.3	0.72
	Christmas trees	78	50			0.55	0.2	0.91	0.15	0.067	0.67	0.39	0.12
	Christmas trees (SLN)	4.5	50			0.032	0.011	16	2.6	0.0039	12	6.7	2.1
	tobacco	4	80			0.045	0.016	11	1.8	0.0055	8.2	4.7	1.5

Table 1: Occupational Handler Short- and Intermediate-Term Exposures and Risks at Baseline Attire continued

Exposure Scenario	Crop Type	Application Rate[a]	Amount Handled[b] (acres unless specified)	Baseline Dermal Unit Exposure (mg/lb ai)[c]	Baseline Inhalation Unit Exposure (ug/lb ai)[d]	Short-Term Baseline Dermal Dose[e]	Intermediate-Term Baseline Dermal Dose[f]	Baseline Short-Term Dermal MOE[g]	Baseline Intermediate-Term Dermal MOE[h]	Baseline Inhalation Dose[i]	Baseline Inhalation MOE[j]	Baseline Short-Term Dermal + Inhalation MOE[k]	Baseline Intermediate-Term Dermal + Inhalation MOE[k]
	potatoes (soil)	3	80			0.034	0.012	15	2.5	0.0041	11	6.3	2
	peas, lentils	2.5	80			0.028	0.01	18	2.9	0.0034	13	7.5	2.4
	peppers, peanuts (SLN), radish grown for seed (SLN)	2	80			0.023	0.0081	22	3.7	0.0027	16	9.4	3
	cabbage	1.5	80			0.017	0.0061	29	4.9	0.0021	22	13	4
	barley, cotton, sorghum, soybeans, wheat	1	200			0.028	0.01	18	2.9	0.0034	13	7.5	2.4
	peanuts, beans (dry, snap, lima), brussels sprout, cauliflower, broccoli, clover grown for seed-SLN	1	80			0.011	0.0041	44	7.4	0.0014	33	19	6
MIXER/LOADER/APPLICATOR													
Loading/Applying with a Push Type Spreader [l] (ORETF) (7)	field-grown ornamental shrubs	109	5	0.35	7.5	2.7	0.98	0.18	0.031	0.058	0.77	0.15	0.029
	field-grown ornamental trees	37	5			0.93	0.33	0.54	0.09	0.02	2.3	0.44	0.087
	field-grown flowers & groundcover	29	5			0.73	0.26	0.69	0.11	0.016	2.9	0.56	0.11
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	5			0.28	0.099	1.8	0.3	0.0059	7.6	1.5	0.29
	Christmas trees	78	5			2	0.7	0.26	0.043	0.042	1.1	0.21	0.041
	Christmas trees (SLN)	4.5	5			0.11	0.041	4.4	0.74	0.0024	19	3.6	0.71
Loading/Applying with a Bellygrinder (PHED) (8)	field-grown ornamental shrubs	109	1	10	62	16	5.6	0.032	0.0054	0.097	0.47	0.03	0.0053
	field-grown ornamental trees	37	1			5.3	1.9	0.095	0.016	0.033	1.4	0.088	0.016
	field-grown flowers & groundcover	29	1			4.1	1.5	0.12	0.02	0.026	1.8	0.11	0.02
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	1			1.6	0.57	0.32	0.053	0.0097	4.6	0.3	0.052

Table 1: Occupational Handler Short- and Intermediate-Term Exposures and Risks at Baseline Attire continued

Exposure Scenario	Crop Type	Application Rate[a]	Amount Handled[b] (acres unless specified)	Baseline Dermal Unit Exposure (mg/lb ai)[c]	Baseline Inhalation Unit Exposure (ug/lb ai)[d]	Short-Term Baseline Dermal Dose[e]	Intermediate-Term Baseline Dermal Dose[f]	Baseline Short-Term Dermal MOE[g]	Baseline Intermediate-Term Dermal MOE[h]	Baseline Inhalation Dose[i]	Baseline Inhalation MOE[j]	Baseline Short-Term Dermal + Inhalation MOE[k]	Baseline Intermediate-Term Dermal + Inhalation MOE[k]
	Christmas trees	78	1			11	4	0.045	0.0075	0.069	0.65	0.042	0.0074
	Christmas trees (SLN)	4.5	1			0.64	0.23	0.78	0.13	0.004	11	0.73	0.13
Loading/Applying Granulars with a Pump-Feed Backpack Spreader [m] (Aldicarb) (9a)	field-grown ornamental shrubs	109	10	No Data	4.2	No Data				0.065	0.69	No Data	
			5	See PPE		See PPE				0.033	1.4	See PPE	
	field-grown ornamental trees	37	10							0.022	2		
			5							0.011	4.1		
	field-grown flowers & groundcover	29	10							0.017	2.6		
			5							0.0087	5.2		
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	10							0.0066	6.8		
			5							0.0033	14		
	coffee trees	8.3	10							0.005	9		
			5							0.0025	18		
	Christmas trees	78	10							0.047	0.96		
			5							0.023	1.9		
	Christmas trees (SLN)	4.5	10							0.0027	17		
			5							0.0014	33		
	potted ornamentals	0.2 lb ai/day	-							0.000012	3800		
Loading/Applying Granular with a Gravity-Feed Backpack Spreader [n] (Fipronil) (9b)	field-grown ornamental shrubs	109	10	No Data	44	No Data				0.69	0.066	No Data	
			5	See PPE		See PPE				0.34	0.13	See PPE	
	field-grown ornamental trees	37	10							0.23	0.19		
			5							0.12	0.39		
	field-grown flowers & groundcover	29	10							0.18	0.25		
			5							0.091	0.49		
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover s	11	10							0.069	0.65		
			5							0.035	1.3		
	coffee trees	8.3	10							0.052	0.86		
			5							0.026	1.7		
	Christmas trees	78	10							0.49	0.092		
			5							0.25	0.18		
	Christmas trees (SLN)	4.5	10							0.028	1.6		
			5							0.014	3.2		
	potted ornamentals	0.2 lb ai/day	-							0.00013	360		

Table 1: Occupational Handler Short- and Intermediate-Term Exposures and Risks at Baseline Attire continued

Exposure Scenario	Crop Type	Application Rate[a]	Amount Handled[b] (acres unless specified)	Baseline Dermal Unit Exposure (mg/lb ai)[c]	Baseline Inhalation Unit Exposure (ug/lb ai)[d]	Short-Term Baseline Dermal Dose[e]	Intermediate-Term Baseline Dermal Dose[f]	Baseline Short-Term Dermal MOE[g]	Baseline Intermediate-Term Dermal MOE[h]	Baseline Inhalation Dose[i]	Baseline Inhalation MOE[j]	Baseline Short-Term Dermal + Inhalation MOE[k]	Baseline Intermediate-Term Dermal + Inhalation MOE[k]
Scoop and Bucket [o] (Fipronil) (10)	field-grown ornamental shrubs	109	10	No Data	45	No Data				0.7	0.064	No Data	
			5	See PPE						0.35	0.13	See PPE	
	field-grown ornamental trees	37	10							0.24	0.19		
			5							0.12	0.38		
	field-grown flowers & groundcover	29	10							0.19	0.24		
			5							0.093	0.48		
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover s	11	10							0.071	0.64		
			5							0.035	1.3		
	coffee trees	8.3	10							0.053	0.84		
			5							0.027	1.7		
	Christmas trees	78	10							0.5	0.09		
			5							0.25	0.18		
	Christmas trees (SLN)	4.5	10							0.029	1.6		
			5							0.014	3.1		
	potted ornamentals	0.2 lb ai/day	-							0.00013	350		
FLAGGER													
Flagging Aerial Spray Applications (11)	tobacco	4	350	0.011	0.35	0.22	0.079	2.3	0.38	0.007	6.4	1.7	0.36
	asparagus (SLN), barley	1	350			0.055	0.02	9.1	1.5	0.0018	26	6.7	1.4
	barley	1	1200			0.19	0.068	2.7	0.44	0.006	7.5	2	0.42
	wheat	0.75	1200			0.14	0.051	3.5	0.59	0.0045	10	2.6	0.56
	sorghum	0.5	1200			0.094	0.034	5.3	0.88	0.003	15	3.9	0.83
	potatoes (foliar). sorghum	0.5	350			0.028	0.0099	18	3	0.00088	51	13	2.9
	cotton (SLN)	0.2	350			0.011	0.004	45	7.6	0.00035	130	34	7.2
Flagging Granular Applications (12)	tobacco	4	350	0.0028	0.15	0.056	0.02	8.9	1.5	0.003	15	5.6	1.4
	potatoes (soil)	3	350			0.042	0.015	12	2	0.0023	20	7.5	1.8
	peas, lentils	2.5	350			0.035	0.013	14	2.4	0.0019	24	9	2.2
	peanuts (SLN)	2	350			0.028	0.01	18	3	0.0015	30	11	2.7
	clover grown for seed (SLN), barley, sorghum, wheat	1	350			0.014	0.005	36	6	0.00075	60	22	5.4
	barley, sorghum, wheat	1	1200			0.048	0.017	10	1.7	0.0026	18	6.5	1.6

Table 1: Occupational Handler Short- and Intermediate-Term Exposures and Risks at Baseline Attire continued

Footnotes:

a Application rates are based on maximum values found on various labels or proposed by registrant. In most scenarios, a range of maximum application rates is used to represent the range of rates for different crops/sites/uses. Most application rates upon which the analysis is based are presented as lb ai/A. In the case of ornamentals in pots, the application rate is presented as lb ai/day). Specific application rates and the corresponding EPA Reg. numbers that are intended as examples of each exposure assessment scenario are presented below:

- 4.0 lb/A EC formulations: tobacco (Reg #3125-307)
- 3.0 lb/A EC formulations: potatoes: foliar OR, WA, ID UT (Reg #3125-307); potatoes: soil (Reg #3125-307); poplars grown for pulpwood (Reg #3125-307--OR-910027)
- 2.5 lb/A EC formulations: peas and lentils (Reg #3125-307)
- 2.0 lb/A EC formulations: beans: dry, snap, lima (Reg #3125-307); cabbage (Reg #3125-307); lettuce (Reg #3125-307); peppers (Reg #3125-307); radish grown for seed (Reg #3125-307-WA-920026);
- 1.0 lb/A EC formulations: asparagus (SLN) (Reg #3125-307-CA-840192); barley (Reg #3125-307); broccoli (Reg #3125-307); Brussels sprouts (Reg #3125-307); cauliflower (Reg #3125-307); cotton (Reg #3125-307); sorghum (Reg #3125-307); wheat (Reg #3125-307);
- 0.75 lb/A EC formulations: wheat (Reg #3125-307)
- 0.5 lb/A EC formulations: sorghum (Reg #3125-307); potatoes: foliar (Reg #3125-307)
- 0.2 lb/A EC formulations: cotton ((Reg #3125-307- TX-860007)
- 109 lb/A Granular formulations: field-grown ornamental shrubs (Reg #3125-172) based on the assumption that the shrubs are two feet tall and occupy two square feet (i.e., roses);
- 78 lb/A Granular formulations: Christmas trees (Reg #3125-172) based on the assumption that the trunk is 2 inches in diameter and are planted 1700 trees per acre;
- 37 lb/A Granular formulations: field-grown ornamental trees (Reg #3125-172) based on the assumption that the trunk is 2 inches in diameters and are planted 800 trees per acre;
- 29 lb/A Granular formulations: field-grown flowers and groundcover (Reg #3125-172)
- 11 lb/A Granular formulations: field-grown ornamental trees and shrubs: injection (Reg #3125-172)
- 8.3 lb/A Granular formulations: coffee trees (Reg #3125-172) based on the assumption that the trees are 8 feet tall and are planted 435 trees per acre
- 4.5 lb/A Granular formulations: Christmas trees ((Reg #3125-172-NC-880001)
- 4.0 lb/A Granular formulations: tobacco (Reg #3125-172);
- 3.0 lb/A Granular formulations: potatoes: soil (Reg #3125-172);
- 2.5 lb/A Granular formulations: peas and lentils (Reg #3125-172);
- 2.0 lb/A Granular formulations: peanuts (Reg #3125-172-NC-920011); peppers (Reg #3125-172); radish grown for seed ((Reg #3125-172-WA-920027);
- 1.5 lb/A Granular formulations: cabbage (Reg #3125-172);
- 1.0 lb/A Granular formulations: barley (Reg #3125-172); beans: dry, snap, lima: (Reg #3125-172); broccoli (Reg #3125-172); Brussels sprouts (Reg #3125-172); cauliflower (Reg #3125-172); clover grown for seed (Reg #3125-172-WA-980004); cotton (Reg #3125-172); peanuts (Reg #3125-172); sorghum (Reg #3125-172); soybeans (Reg #3125-172); wheat (Reg #3125-172);
- 0.2 lb/day Granular formulations: potted ornamentals (Reg #3125-172); based on the assumption that 350 pots that are 12 inches in diameter are treated each day;

b Amount handled per day values are based on HED Exposure SAC Policy # 009 "Standard Values for Daily Acres Treated in Agriculture," revised June 23, 2000, or best professional judgment when data is not available.

c Unless otherwise footnoted, baseline dermal unit exposure values are from PHED Surrogate Exposure Guide, draft version August, 1998. Baseline dermal exposure assumes long pants, long sleeved shirt, no gloves, open mixing/loading, open cab/tractor. (See *Exposure Scenarios Descriptions Table* for further information.)

d Unless otherwise footnoted, inhalation unit exposure values are from PHED Surrogate Exposure Guide, draft version August, 1998. Baseline inhalation exposure assessed as a no respirator scenario .

e Short-term baseline dermal dose (mg/kg/d) = [unit dermal exposure (mg/lb ai) * application rate (lb ai/acre) * daily acres treated * dermal absorption (100%)]/ body weight (70 kg).

f Intermediate-term baseline dermal dose (mg/kg/d) = [unit dermal exposure (mg/lb ai) * application rate (lb ai/acre) * daily acres treated * dermal absorption (36%)]/ body weight (70 kg).

g Short-term dermal MOE = NOAEL (0.5 mg/kg/d) / short-term daily dermal dose. Uncertainty Factor = 100.

h Intermediate-term dermal MOE = NOAEL (0.03 mg/kg/day) / intermediate-term daily dermal dose.. Uncertainty Factor = 100.

i Baseline Inhalation Dose (mg/kg/d) = (unit exposure (μg/lb ai) * (1mg/1000 μg) conversion * appl. rate (lb ai/A) * acres treated/day)/body weight (70 kg) [Note: application rate and acres treated/day are replaced by pounds handled per day for ornamentals in pots scenario.

j Baseline inhalation MOE = NOAEL (0.045 mg/kg/day) / short-term inhalation dose. Uncertainty Factor = 100.

k Total Baseline Short- or Intermediate-term MOE =

$$\frac{1}{\frac{1}{\text{dermal MOE}} + \frac{1}{\text{inhalation MOE}}}$$

l Unit exposure values from Outdoor Residential Exposure Task Force study: ORETF Study Number OMA001. "*Exposure of Professional Lawn Care Workers During the Mixing, Loading and Application of Granular Turf Pesticides Utilizing a Surrogate Compound*". Values from EPA memo dated April 30, 2001 using same standard clothing assumptions as for PHED (footnotes c and d). Geometric mean is used for dermal values and median is used for inhalation value.

m Unit exposure values from a loader/applicator study using passive dosimetry and pump-feed backpack equipment to load and apply aldicarb granules to the soil at the base of banana trees. MRID # 451672-01 *Worker Exposure Study During Application in Banana Plantation with Temik 10G*. Applicators wore baseline attire plus Tyvek gloves and a back apron. Geometric mean is used for dermal and inhalation values.

Table 1: Occupational Handler Short- and Intermediate-Term Exposures and Risks at Baseline Attire continued

n Unit exposure values from a loader/applicator study using passive dosimetry and gravity-feed backpack equipment to load and apply fipronil granules to the soil at the base of banana trees. MRID # 452507-02 *Worker Exposure Study During Application of Regent 10GR in Banana* Plantation. Applicators wore baseline attire plus PVC gloves. Geometric mean is used for dermal and inhalation values.

o Unit exposure values from a loader/applicator study using passive dosimetry and handheld bucket and scoop equipment to load and apply fipronil granules to the soil at the base of banana trees. MRID # 452507-02 *Worker Exposure Study During Application of Regent 10GR in Banana Plantation.* Applicators wore baseline attire plus PVC gloves. Geometric mean is used for dermal and inhalation values.

Table 2: Occupational Handler Short-Term Exposures and Risks with Personal Protective Equipment

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (no respirator) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (no respirator) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (no respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
MIXER/LOADER														
Mixing/Loading Liquid Formulations for Aerial Application (1a)	tobacco	4	350	0.023	0.017	1.1	1.5	0.24	1.9	9.4	0.69	0.97	0.82	1.3
	asparagus (SLN)	1	350			4.3	5.9		7.5	38	2.8	3.9	3.3	5.1
	barley	1	1200			1.3	1.7		2.2	11	0.8	1.1	0.96	1.5
	wheat	0.75	1200			1.7	2.3		2.9	15	1.1	1.5	1.3	2
	sorghum	0.5	1200			2.5	3.4		4.4	22	1.6	2.3	1.9	3
	potatoes (foliar)	0.5	350			8.7	12		15	75	5.5	7.8	6.6	10
	cotton (SLN)	0.2	1200			6.3	8.6		11	55	4	5.7	4.8	7.4
Mixing/Loading Liquid Formulations for Chemigation Application (1b)	potatoes (foliar) - OR, WA, ID, UT	3	350			1.4	2		2.5	13	0.92	1.3	1.1	1.7
	poplars grown for pulpwood (SLN)	3	350			1.4	2		2.5	13	0.92	1.3	1.1	1.7
	cabbage, lettuce	2	350			2.2	2.9		3.8	19	1.4	1.9	1.6	2.5
	broccoli, brussels sprouts, cauliflower, cotton	1	350			4.3	5.9		7.5	38	2.8	3.9	3.3	5.1
Mixing/Loading Liquid Formulations for Groundboom Application (1c)	tobacco	4	80			4.8	6.4		8.2	41	3	4.3	3.6	5.6
	poplars grown for pulpwood (SLN)	3	80			6.3	8.6		11	55	4	5.7	4.8	7.4
	potatoes (soil)	3	80			6.3	8.6		11	55	4	5.7	4.8	7.4
	peas, lentils	2.5	80			7.6	10		13	66	4.8	6.8	5.8	8.9
	beans(dry, snap, lima), lettuce, peppers, radish grown for seed, cabbage	2	80			9.5	13		16	82	6	8.5	7.2	11
	wheat, barley, cotton, sorghum	1	200			7.6	10		13	66	4.8	6.8	5.8	8.9
	asparagus (SLN), broccoli, brussels sprouts, cauliflower	1	80			19	26		33	160	12	17	14	22
	potatoes (foliar)	0.5	80			38	51		66	330	24	34	29	44
Loading Granular Formulations for Aerial Application (2a)	tobacco	4	350	0.0069	0.0034	3.6	7.4	0.34	1.3	6.6	0.97	2.3	1.1	3.5
	potatoes (soil)	3	350			4.8	9.8		1.8	8.8	1.3	3.1	1.5	4.6
	peas, lentils	2.5	350			5.8	12		2.1	11	1.6	3.7	1.8	5.6
	peanuts (SLN)	2	350			7.2	15		2.6	13	1.9	4.7	2.2	7

Table 2 Occupational Handler Short-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (no respirator) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (no respirator) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (no respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
	clover grown for seed (SLN)	1	350			14	29		5.3	26	3.9	9.4	4.5	14
	barley, sorghum, wheat	1	1200			4.2	8.6		1.5	7.7	1.1	2.7	1.3	4.1
Loading Granular Formulations for Ground Application (2b)	field-grown ornamental shrubs	109	40			1.2	2.4		0.42	2.1	0.31	0.75	0.36	1.1
	field-grown ornamental trees	37	40			3.4	7		1.3	6.3	0.92	2.2	1.1	3.3
	field-grown flowers & groundcover	29	40			4.4	8.9		1.6	8	1.2	2.8	1.4	4.2
	field-grown ornamental trees and shrubs (inject) and flowers & groundcover	11	40			12	23		4.2	21	3.1	7.4	3.6	11
	coffee trees	8.3	80			7.6	16		2.8	14	2	4.9	2.4	7.3
	Christmas trees	78	50			1.3	2.6		0.48	2.4	0.35	0.84	0.4	1.3
	Christmas trees (SLN)	4.5	50			23	46		8.2	41	6	15	7	22
	tobacco	4	80			16	32		5.8	29	4.2	10	4.9	15
	potatoes (soil)	3	80			21	43		7.7	39	5.7	14	6.5	20
	peas, lentils	2.5	80			25	51		9.3	46	6.8	16	7.9	24
	peppers, peanuts (SLN), radish grown for seed (SLN)	2	80			32	64		12	58	8.5	20	9.8	30
	cabbage	1.5	80			42	86		15	77	11	27	13	41
	barley, cotton, sorghum, soybeans, wheat	1	200			25	51		9.3	46	6.8	16	7.9	24
	peanuts, beans (dry, snap, lima), brussels sprout, cauliflower, broccoli, clover grown for seed (SLN)	1	80			63	130		23	120	17	41	20	61
APPLICATOR														

Table 2 Occupational Handler Short-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (no respirator) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (no respirator) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (no respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
Applying Sprays with an Airplane (3)	tobacco	4	350	No Data See Engineering Controls										
	asparagus (SLN)	1	350											
	barley	1	1200											
	wheat	0.75	1200											
	sorghum	0.5	1200											
	potatoes (foliar)	0.5	350											
	cotton (SLN)	0.2	1200											
Applying Granulars with an Airplane (4)	tobacco	4	350	No Data See Engineering Controls										
	potatoes (soil)	3	350											
	peas, lentils	2.5	350											
	peanuts (SLN)	2	350											
	barley, sorghum, wheat	1	1200											
	clover grown for seed (SLN)	1	350											
Applying with a Groundboom (5)	tobacco	4	80	0.014	0.011	7.8	9.9	0.15	13	66	4.9	7	5.7	8.6
	poplars grown for pulpwood (SLN)	3	80			10	13		18	88	6.6	9.3	7.6	12
	potatoes (soil)	3	80			10	13		18	88	6.6	9.3	7.6	12
	peas, lentils	2.5	80			13	16		21	110	7.9	11	9.1	14
	beans(dry, snap, lima), lettuce, peppers, radish grown for seed, cabbage	2	80			16	20		27	130	9.8	14	11	17
	wheat, barley, cotton, sorghum	1	200			13	16		21	110	7.9	11	9.1	14
	asparagus (SLN), broccoli, brussels sprouts, cauliflower	1	80			31	40		53	260	20	28	23	35
	potatoes (foliar)	0.5	80			63	80		110	530	39	56	46	69
Applying Granulars with a Tractor Drawn Spreader (6)	field-grown ornamental shrubs	109	40	0.0072	0.042	1.1	1.9	0.24	0.6	3	0.39	0.81	0.46	1.2

Table 2 Occupational Handler Short-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (no respirator) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (no respirator) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (no respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
	field-grown ornamental trees	37	40			3.3	5.6		1.8	8.9	1.2	2.4	1.3	3.4
	field-grown flowers & groundcover	29	40			4.2	7.2		2.3	11	1.5	3.1	1.7	4.4
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	40			11	19		6	30	3.9	8.1	4.5	12
	coffee trees	8.3	80			7.3	13		4	20	2.6	5.3	3	7.7
	Christmas trees	78	50			1.2	2.1		0.67	3.4	0.44	0.91	0.51	1.3
	Christmas trees (SLN)	4.5	50			22	37		12	58	7.6	16	8.9	23
	tobacco	4	80			15	26		8.2	41	5.3	11	6.2	16
	potatoes (soil)	3	80			20	35		11	55	7.1	15	8.3	21
	peas, lentils	2.5	80			24	42		13	66	8.5	18	10	25
	peppers, peanuts (SLN), radish grown for seed (SLN)	2	80			30	52		16	82	11	22	12	32
	cabbage	1.5	80			41	69		22	110	14	30	17	42
	barley, cotton, sorghum, soybeans, wheat	1	200			24	42		13	66	8.5	18	10	25
	peanuts, beans (dry, snap, lima), brussels sprout, cauliflower, broccoli, clover grown for seed-SLN	1	80			61	100		33	160	21	44	25	64
MIXER/LOADER/APPLICATOR														
Loading/Applying with a Push Type Spreader[i] (ORETF) (7)	field-grown ornamental shrubs	109	5	0.22	0.11	0.29	0.58	1.5	0.77	3.9	0.21	0.27	0.33	0.51
	field-grown ornamental trees	37	5			0.86	1.7		2.3	11	0.62	0.8	0.98	1.5

Table 2 Occupational Handler Short-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (no respirator) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (no respirator) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (no respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
	field-grown flowers & groundcover	29	5			1.1	2.2		2.9	14	0.8	1	1.2	1.9
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	5			2.9	5.8		7.6	38	2.1	2.7	3.3	5
	Christmas trees	78	5			0.41	0.82		1.1	5.4	0.3	0.38	0.46	0.71
	Christmas trees (SLN)	4.5	5			7.1	14		19	93	5.1	6.6	8	12
Loading/Applying with a Bellygrinder (PHED) (8)	field-grown ornamental shrubs	109	1	9.3	5.7	0.035	0.056	12	0.47	2.4	0.032	0.034	0.05	0.055
	field-grown ornamental trees	37	1			0.1	0.17		1.4	7.1	0.095	0.1	0.15	0.16
	field-grown flowers & groundcover	29	1			0.13	0.21		1.8	9.1	0.12	0.13	0.19	0.21
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	1			0.34	0.56		4.6	24	0.32	0.34	0.5	0.55
	Christmas trees	78	1			0.048	0.079		0.65	3.4	0.045	0.048	0.07	0.077
	Christmas trees (SLN)	4.5	1			0.84	1.4		11	58	0.78	0.82	1.2	1.3
Loading/Applying Granulars with a Pump-Feed Backpack Spreader[j] (Aldicarb) (9a)	field-grown ornamental shrubs	109	10	0.01 with apron on back	No Data	3.2 (apron)	No Data	0.84	0.69	3.4	0.57 (apron)	1.7 (apron)	No Data	No Data
			5			6.4 (apron)			1.4	6.9	1.1 (apron)	3.3 (apron)		
	field-grown ornamental trees	37	10			9.5 (apron)			2	10	1.7 (apron)	4.9 (apron)		
			5			19 (apron)			4.1	20	3.3 (apron)	9.8 (apron)		
	field-grown flowers & groundcover	29	10			12 (apron)			2.6	13	2.1 (apron)	6.2 (apron)		
			5			24 (apron)			5.2	26	4.3 (apron)	12 (apron)		
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	10			32 (apron)			6.8	34	5.6 (apron)	16 (apron)		
			5			64 (apron)			14	68	11 (apron)	33 (apron)		
	coffee trees	8.3	10			42 (apron)			9	45	7.4 (apron)	22 (apron)		
			5			84 (apron)			18	90	15 (apron)	44 (apron)		

Table 2 Occupational Handler Short-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (no respirator) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (no respirator) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (no respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
	Christmas trees	78	10			4.5 (apron)			0.96	4.8	0.79 (apron)	2.3 (apron)		
			5			9 (apron)			1.9	9.6	1.6 (apron)	4.6 (apron)		
	Christmas trees (SLN)	4.5	10			78 (apron)			17	83	14 (apron)	40 (apron)		
			5			160 (apron)			33	170	27 (apron)	80 (apron)		
	Potted ornamentals	0.2 lb ai/day	-			18000 (apron)			3800	19000	3100 (apron)	9100 (apron)		
Loading/Applying Granular with a Gravity-Feed Backpack Spreader [k] (Fipronil) (9b)	field-grown ornamental shrubs	109	10	0.6	No Data	0.054	No Data	8.8	0.066	0.33	0.029	0.046	No Data	No Data
			5			0.11			0.13	0.66	0.059	0.092		
	field-grown ornamental trees	37	10			0.16			0.19	0.97	0.087	0.14	No Data	No Data
			5			0.32			0.39	1.9	0.17	0.27		
	field-grown flowers & groundcover	29	10			0.2			0.25	1.2	0.11	0.17		
			5			0.4			0.49	2.5	0.22	0.35		
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	10			0.53			0.65	3.3	0.29	0.46		
			5			1.1			1.3	6.5	0.58	0.91		
	coffee trees	8.3	10			0.7			0.86	4.3	0.39	0.6		
			5			1.4			1.7	8.6	0.77	1.2		
	Christmas trees	78	10			0.075			0.092	0.46	0.041	0.064		
			5			0.15			0.18	0.92	0.082	0.13		
	Christmas trees (SLN)	4.5	10			1.3			1.6	8	0.71	1.1		
			5			2.6			3.2	16	1.4	2.2		
	Potted ornamentals	0.2 lb ai/day	-			290			360	1800	160	250		
Scoop and Bucket [l] (Fipronil) (10)	field-grown ornamental shrubs	109	10	2	No Data	0.016	No Data	9	0.064	0.32	0.013	0.015		
			5			0.032			0.13	0.64	0.026	0.031		
	field-grown ornamental trees	37	10			0.047			0.19	0.95	0.038	0.045		
			5			0.095			0.38	1.9	0.076	0.09		
	field-grown flowers & groundcover	29	10			0.06			0.24	1.2	0.048	0.057		
			5			0.12			0.48	2.4	0.097	0.11		
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	10			0.16			0.64	3.2	0.13	0.15		
			5			0.32			1.3	6.4	0.25	0.3		
	coffee trees	8.3	10			0.21			0.84	4.2	0.17	0.2		
			5			0.42			1.7	8.4	0.34	0.4		
	Christmas trees	78	10			0.022			0.09	0.45	0.018	0.021		

Table 2 Occupational Handler Short-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (no respirator) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (no respirator) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (no respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
			5			0.045			0.18	0.9	0.036	0.043		
	Christmas trees (SLN)	4.5	10			0.39			1.6	7.8	0.31	0.37		
			5			0.78			3.1	16	0.62	0.74		
	Potted ornamentals	0.2 lb ai/day	-			88			350	1800	70	83		
FLAGGER														
Flagging Aerial Spray Applications (11)	tobacco	4	350	Not applicable	0.01 double layers only; no gloves	Not applicable	2.5 (no gloves)	0.07	6.4	32	Not applicable	Not applicable	1.8 (no gloves)	2.3 (no gloves)
	asparagus (SLN), barley	1	350				10 (no gloves)		26	130			7.2 (no gloves)	9.3 (no gloves)
	barley	1	1200				2.9 (no gloves)		7.5	38			2.1 (no gloves)	2.7 (no gloves)
	wheat	0.75	1200				3.9 (no gloves)		10	50			2.8 (no gloves)	3.6 (no gloves)
	sorghum	0.5	1200				5.8 (no gloves)		15	75			4.2 (no gloves)	5.4 (no gloves)
	potatoes (foliar), sorghum	0.5	350				20 (no gloves)		51	260			14 (no gloves)	19 (no gloves)
	cotton (SLN)	0.2	350				50 (no gloves)		130	640			36 (no gloves)	46 (no gloves)
Flagging Granular Applications (12)	tobacco	4	350	Not applicable	0.0016 double layers only; no gloves	Not applicable	16 (no gloves)	0.03	15	75	Not applicable	Not applicable	7.7 (no gloves)	13 (no gloves)
	potatoes (soil)	3	350				21 (no gloves)		20	100			10 (no gloves)	17 (no gloves)
	peas, lentils	2.5	350				25 (no gloves)		24	120			12 (no gloves)	21 (no gloves)
	peanuts (SLN)	2	350				31 (no gloves)		30	150			15 (no gloves)	26 (no gloves)
	clover grown for seed (SLN), barley, sorghum, wheat	1	350				63 (no gloves)		60	300			31 (no gloves)	52 (no gloves)
	barley, sorghum, wheat	1	1200				18 (no gloves)		18	88			8.9 (no gloves)	15 (no gloves)

Footnotes:

a Application rates are based on maximum values found on various labels or proposed by registrant. In most scenarios, a range of maximum application rates is used to represent the range of rates for different crops/sites/uses. Most application rates upon which the analysis is based are presented as lb ai/A. In the case of ornamentals in pots, the application rate is presented as lb ai/day). Specific application rates and the corresponding EPA Reg. numbers that are intended as examples of each exposure assessment scenario are presented in the table indicating risks at baseline attire.

Table 2 Occupational Handler Short-Term Exposures and Risks with Personal Protective Equipment continued

b Amount handled per day values are based on HED Exposure SAC Policy # 009 "Standard Values for Daily Acres Treated in Agriculture," revised June 23, 2000, or best professional judgment when data is not available.

c Unless otherwise footnoted, personal protective equipment dermal unit exposure values are from PHED Surrogate Exposure Guide, draft version August, 1998. PPE dermal exposure assumes long pants, long sleeved shirt, plus gloves and/or double-layer body protection; open mixing/loading, open cab/tractor. (See *Exposure Scenarios Descriptions Table* for further information.)

d Short-term dermal MOE = NOAEL (0.5 mg/kg/day / short-term PPE daily dermal dose (mg/kg/day), where daily dermal dose = [unit dermal exposure (mg/lb ai) * application rate (lb ai/acre) * daily acres treated * dermal absorption (100%)]/ body weight (70 kg). [Note: application rate and acres treated/day are replaced by pounds handled per day for ornamentals in pots scenario.] Uncertainty Factor = 100.

e Unless otherwise footnoted, personal protective equipment inhalation unit exposure values are from PHED Surrogate Exposure Guide, draft version August, 1998 representing use of a dust mist respirator -- calculated using an 80% protection factor from baseline inhalation exposure values.

f Baseline Inhalation MOE from table indicating risks at baseline attire (no respirator)

g PPE Inhalation MOE = NOAEL (0.045 mg/kg/day) / PPE inhalation dose, where daily PPE inhalation dose = (unit exposure (μg/lb ai) * (1mg/1000 μg) conversion * appl. rate (lb ai/A) * acres treated/day)/body weight (70 kg) [Note: application rate and acres treated/day are replaced by pounds handled per day for ornamentals in pots scenario.] Uncertainty Factor = 100.

h Total PPE Short-term MOE =

$$\frac{1}{\frac{1}{\text{dermal MOE}} + \frac{1}{\text{inhalation MOE}}}$$

i Unit exposure values from Outdoor Residential Exposure Task Force study: ORETF Study Number OMA001. "*Exposure of Professional Lawn Care Workers During the Mixing, Loading and Application of Granular Turf Pesticides Utilizing a Surrogate Compound*". Values from EPA memo dated April 30, 2001 using same standard PPE assumptions as for PHED (footnotes c and e). Geometric mean is used for dermal values and median is used for inhalation value.

j Unit exposure values from a loader/applicator study using passive dosimetry and pump-feed backpack equipment to load and apply aldicarb granules to the soil at the base of banana trees. MRID # 451672-01 *Worker Exposure Study During Application in Banana Plantation with Temik 10G*. Applicators wore baseline attire plus Tyvek gloves and a back apron. Geometric mean is used for dermal and inhalation values.

k Unit exposure values from a loader/applicator study using passive dosimetry and gravity-feed backpack equipment to load and apply fipronil granules to the soil at the base of banana trees. MRID # 452507-02 *Worker Exposure Study During Application of Regent 10GR in Banana* Plantation. Applicators wore baseline attire plus PVC gloves. Geometric mean is used for dermal and inhalation values.

l Unit exposure values from a loader/applicator study using passive dosimetry and handheld bucket and scoop equipment to load and apply fipronil granules to the soil at the base of banana trees. MRID # 452507-02 *Worker Exposure Study During Application of Regent 10GR in Banana Plantation.* Applicators wore baseline attire plus PVC gloves. Geometric mean is used for dermal and inhalation values.

Table 3: Occupational Handler Intermediate-Term Exposures and Risks with Personal Protective Equipment

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (baseline) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (baseline) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (baseline) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
MIXER/LOADER														
Mixing/Loading Liquid Formulations for Aerial Application (1a)	tobacco	4	350	0.023	0.017	0.18	0.25	0.24	1.9	9.4	0.17	0.18	0.22	0.24
	asparagus (SLN)	1	350			0.72	0.98		7.5	38	0.66	0.71	0.87	0.96
	barley	1	1200			0.21	0.29		2.2	11	0.19	0.21	0.25	0.28
	wheat	0.75	1200			0.28	0.38		2.9	15	0.26	0.28	0.34	0.37
	sorghum	0.5	1200			0.42	0.57		4.4	22	0.39	0.41	0.51	0.56
	potatoes (foliar)	0.5	350			1.4	2		15	75	1.3	1.4	1.7	1.9
	cotton (SLN)	0.2	1200			1.1	1.4		11	55	0.96	1	1.3	1.4
Mixing/Loading Liquid Formulations for Chemigation Application (1b)	potatoes (foliar) - OR, WA, ID, UT	3	350			0.24	0.33		2.5	13	0.22	0.24	0.29	0.32
	poplars grown for pulpwood (SLN)	3	350			0.24	0.33		2.5	13	0.22	0.24	0.29	0.32
	cabbage, lettuce	2	350			0.36	0.49		3.8	19	0.33	0.36	0.43	0.48
	broccoli, brussels sprouts, cauliflower, cotton	1	350			0.72	0.98		7.5	38	0.66	0.71	0.87	0.96
Mixing/Loading Liquid Formulations for Groundboom Application (1c)	tobacco	4	80			0.79	1.1		8.2	41	0.72	0.78	0.95	1
	poplars grown for pulpwood (SLN)	3	80			1.1	1.4		11	55	0.96	1	1.3	1.4
	potatoes (soil)	3	80			1.1	1.4		11	55	0.96	1	1.3	1.4
	peas, lentils	2.5	80			1.3	1.7		13	66	1.2	1.2	1.5	1.7
	beans(dry, snap, lima), lettuce, peppers, radish grown for seed, cabbage	2	80			1.6	2.1		16	82	1.4	1.6	1.9	2.1
	wheat, barley, cotton, sorghum	1	200			1.3	1.7		13	66	1.2	1.2	1.5	1.7
	asparagus (SLN), broccoli, brussels sprouts, cauliflower	1	80	0.023	0.017	3.2	4.3	0.24	33	160	2.9	3.1	3.8	4.2
	potatoes (foliar)	0.5	80			6.3	8.6		66	330	5.8	6.2	7.6	8.4

Table 3: Occupational Handler Intermediate-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (baseline) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (baseline) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (baseline) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
Loading Granular Formulations for Aerial Application (2a)	tobacco	4	350	0.0069	0.0034	0.6	1.2	0.34	1.3	6.6	0.41	0.55	0.64	1
	potatoes (soil)	3	350			0.81	1.6		1.8	8.8	0.55	0.74	0.85	1.4
	peas, lentils	2.5	350			0.97	2		2.1	11	0.66	0.89	1	1.7
	peanuts (SLN)	2	350			1.2	2.5		2.6	13	0.83	1.1	1.3	2.1
	clover grown for seed (SLN)	1	350			2.4	4.9		5.3	26	1.7	2.2	2.5	4.1
	barley, sorghum, wheat	1	1200			0.7	1.4		1.5	7.7	0.48	0.65	0.74	1.2
Loading Granular Formulations for Ground Application (2b)	field-grown ornamental shrubs	109	40			0.19	0.39		0.42	2.1	0.13	0.18	0.2	0.33
	field-grown ornamental trees	37	40			0.57	1.2		1.3	6.3	0.39	0.52	0.6	0.98
	field-grown flowers & groundcover	29	40			0.73	1.5		1.6	8	0.5	0.67	0.77	1.2
	field-grown ornamental trees and shrubs (inject) and flowers & groundcover	11	40			1.9	3.9		4.2	21	1.3	1.8	2	3.3
	coffee trees	8.3	80			1.3	2.6		2.8	14	0.87	1.2	1.3	2.2
	Christmas trees	78	50			0.22	0.44		0.48	2.4	0.15	0.2	0.23	0.37
	Christmas trees (SLN)	4.5	50			3.8	7.6		8.2	41	2.6	3.4	4	6.4
	tobacco	4	80			2.6	5.4		5.8	29	1.8	2.4	2.8	4.5
	potatoes (soil)	3	80			3.5	7.1		7.7	39	2.4	3.2	3.7	6
	peas, lentils	2.5	80			4.2	8.6		9.3	46	2.9	3.9	4.5	7.2
	peppers, peanuts (SLN), radish grown for seed (SLN)	2	80			5.3	11	0.34	12	58	3.6	4.8	5.6	9
	cabbage	1.5	80			7	14		15	77	4.8	6.5	7.4	12
	barley, cotton, sorghum, soybeans, wheat	1	200			4.2	8.6		9.3	46	2.9	3.9	4.5	7.2

Table 3: Occupational Handler Intermediate-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (baseline) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (baseline) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (baseline) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
	peanuts, beans (dry, snap, lima), brussels sprout, cauliflower, broccoli, clover grown for seed (SLN)	1	80			11	21		23	120	7.3	9.7	11	18
APPLICATOR														
Applying Sprays with an Airplane (3)	tobacco	4	350	No Data See Engineering Controls										
	asparagus (SLN)	1	350											
	barley	1	1200											
	wheat	0.75	1200											
	sorghum	0.5	1200											
	potatoes (foliar)	0.5	350											
	cotton (SLN)	0.2	1200											
Applying Granulars with an Airplane (4)	tobacco	4	350	No Data See Engineering Controls										
	potatoes (soil)	3	350											
	peas, lentils	2.5	350											
	peanuts (SLN)	2	350											
	barley, sorghum, wheat	1	1200											
	clover grown for seed (SLN)	1	350											
Applying with a Groundboom (5)	tobacco	4	80	0.014	0.011	1.3	1.7	0.15	13	66	1.2	1.3	1.5	1.6
	poplars grown for pulpwood (SLN)	3	80			1.7	2.2		18	88	1.6	1.7	2	2.2
	potatoes (soil)	3	80			1.7	2.2	0.15	18	88	1.6	1.7	2	2.2
	peas, lentils	2.5	80			2.1	2.7		21	110	1.9	2	2.4	2.6
	beans(dry, snap, lima), lettuce, peppers, radish grown for seed, cabbage	2	80			2.6	3.3	0.15	27	130	2.4	2.6	2.9	3.2
	wheat, barley, cotton, sorghum	1	200			2.1	2.7		21	110	1.9	2	2.4	2.6

Table 3: Occupational Handler Intermediate-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (baseline) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (baseline) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (baseline) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
	asparagus (SLN), broccoli, brussels sprouts, cauliflower	1	80			5.2	6.6		53	260	4.7	5.1	5.9	6.5
	potatoes (foliar)	0.5	80			10	13		110	530	9.5	10	12	13
Applying Granulars with a Tractor Drawn Spreader (6)	field-grown ornamental shrubs	109	40	0.0072	0.0042	0.19	0.32	0.24	0.6	3	0.14	0.18	0.21	0.29
	field-grown ornamental trees	37	40			0.55	0.94		1.8	8.9	0.42	0.52	0.61	0.85
	field-grown flowers & groundcover	29	40			0.7	1.2		2.3	11	0.53	0.66	0.78	1.1
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	40			1.8	3.2		6	30	1.4	1.7	2.1	2.9
	coffee trees	8.3	80			1.2	2.1		4	20	0.93	1.1	1.4	1.9
	Christmas trees	78	50			0.21	0.36		0.67	3.4	0.16	0.2	0.23	0.32
	Christmas trees (SLN)	4.5	50			3.6	6.2		12	58	2.8	3.4	4	5.6
	tobacco	4	80			2.5	4.3		8.2	41	1.9	2.4	2.8	3.9
	potatoes (soil)	3	80			3.4	5.8		11	55	2.6	3.2	3.8	5.2
	peas, lentils	2.5	80			4.1	6.9		13	66	3.1	3.8	4.5	6.3
	peppers, peanuts (SLN), radish grown for seed (SLN)	2	80			5.1	8.7		16	82	3.9	4.8	5.7	7.8
	cabbage	1.5	80			6.8	12		22	110	5.2	6.4	7.6	10
	barley, cotton, sorghum, soybeans, wheat	1	200			4.1	6.9		13	66	3.1	3.8	4.5	6.3
	peanuts, beans (dry, snap, lima), brussels sprout, cauliflower, broccoli, clover grown for seed-SLN	1	80			10	17		33	160	7.7	9.5	11	16

Table 3: Occupational Handler Intermediate-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (baseline) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (baseline) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (baseline) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
MIXER/LOADER/APPLICATOR														
Loading/Applying with a Push Type Spreader [i] (ORETF) (7)	field-grown ornamental shrubs	109	5	0.22	0.11	0.049	0.097	1.5	0.77	3.9	0.046	0.048	0.086	0.095
	field-grown ornamental trees	37	5			0.14	0.29		2.3	11	0.13	0.14	0.25	0.28
	field-grown flowers & groundcover	29	5			0.18	0.37		2.9	14	0.17	0.18	0.32	0.36
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	5			0.48	0.96		7.6	38	0.45	0.48	0.86	0.94
	Christmas trees	78	5			0.068	0.14		1.1	5.4	0.064	0.067	0.12	0.13
	Christmas trees (SLN)	4.5	5			1.2	2.4		19	93	1.1	1.2	2.1	2.3
Loading/Applying with a Bellygrinder (PHED) (8)	field-grown ornamental shrubs	109	1	9.3	5.7	0.0058	0.0094	12	0.47	2.4	0.0057	0.0057	0.0092	0.0094
	field-grown ornamental trees	37	1			0.017	0.028		1.4	7.1	0.017	0.017	0.027	0.028
	field-grown flowers & groundcover	29	1			0.022	0.035	12	1.8	9.1	0.021	0.022	0.035	0.035
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	1			0.057	0.093		4.6	24	0.056	0.057	0.091	0.093
	Christmas trees	78	1			0.008	0.013		0.65	3.4	0.0079	0.008	0.013	0.013
	Christmas trees (SLN)	4.5	1			0.14	0.23		11	58	0.14	0.14	0.22	0.23
Loading/Applying Granulars with a Pump-Feed Backpack Spreader [j] (Aldicarb) (9a)	field-grown ornamental shrubs	109	10	0.01	No Data	0.54	No Data	0.84	0.69	3.4	0.3 (apron)	0.46 (apron)	No Data	No Data
			5			1.1			1.4	6.9	0.6 (apron)	0.93 (apron)		
	field-grown ornamental trees	37	10			1.6			2	10	0.89 (apron)	1.4 (apron)		
			5			3.2			4.1	20	1.8 (apron)	2.7 (apron)		
	field-grown flowers & groundcover	29	10			2			2.6	13	1.1 (apron)	1.7 (apron)		
			5			4			5.2	26	2.3 (apron)	3.5 (apron)		

Table 3: Occupational Handler Intermediate-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (baseline) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (baseline) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (baseline) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	10			5.3			6.8	34	3 (apron)	4.6 (apron)		
			5			11			14	68	6 (apron)	9.2 (apron)		
	coffee trees	8.3	10			7			9	45	4 (apron)	6.1 (apron)		
			5			14			18	90	7.9 (apron)	12 (apron)		
	Christmas trees	78	10			0.75			0.96	4.8	0.42	0.65		
			5			1.5			1.9	9.6	0.84	1.3		
	Christmas trees (SLN)	4.5	10			13			17	83	7.3	11		
			5			26			33	170	15	22		
	Potted ornamentals	0.2 lb ai/day	--			2900			3800	19000	1600	2500		

Table 3: Occupational Handler Intermediate-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (baseline) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (baseline) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (baseline) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
Loading/Applying Granular with a Gravity-Feed Backpack Spreader [k] (Fipronil) (9b)	field-grown ornamental shrubs	109	10	0.6	No Data	0.0089	No Data	8.8	0.066	0.33	0.0079	0.0087	No Data	No Data
			5			0.018			0.13	0.66	0.016	0.017		
	field-grown ornamental trees	37	10			0.026			0.19	0.97	0.023	0.026		
			5			0.053			0.39	1.9	0.046	0.051		
	field-grown flowers & groundcover	29	10			0.034			0.25	1.2	0.03	0.033	No Data	No Data
			5			0.067			0.49	2.5	0.059	0.065		
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	10			0.088			0.65	3.3	0.078	0.086		
			5			0.18			1.3	6.5	0.16	0.17		
	coffee trees	8.3	10			0.12			0.86	4.3	0.1	0.11		
			5			0.23			1.7	8.6	0.21	0.23		
	Christmas trees	78	10			0.012			0.092	0.46	0.011	0.012		
			5			0.025			0.18	0.92	0.022	0.024		
	Christmas trees (SLN)	4.5	10			0.22			1.6	8	0.19	0.21		
			5			0.43			3.2	16	0.38	0.42		
	Potted ornamentals	0.2 lb ai/day	--			49			360	1800	43	47		

Table 3: Occupational Handler Intermediate-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (baseline) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (baseline) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (baseline) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
Scoop and Bucket [1] (Fipronil) (10)	field-grown ornamental shrubs	109	10	2	No Data	0.0027	No Data	9	0.064	0.32	0.0026	0.0027	No Data	No Data
			5			0.0054			0.13	0.64	0.0051	0.0053		
	field-grown ornamental trees	37	10			0.0079			0.19	0.95	0.0076	0.0078		
			5			0.016			0.38	1.9	0.015	0.016		
	field-grown flowers & groundcover	29	10			0.01			0.24	1.2	0.0097	0.01		
			5			0.02			0.48	2.4	0.019	0.02		
	field-grown ornamental trees & shrubs (inject) and flowers & groundcovers	11	10			0.027			0.64	3.2	0.025	0.026		
			5			0.053			1.3	6.4	0.051	0.053		
	coffee trees	8.3	10			0.035			0.84	4.2	0.034	0.035		
			5			0.07			1.7	8.4	0.067	0.07		
	Christmas trees	78	10			0.0037			0.09	0.45	0.0036	0.0037		
			5			0.0075			0.18	0.9	0.0072	0.0074		
	Christmas trees (SLN)	4.5	10			0.065			1.6	7.8	0.062	0.064		
			5			0.13			3.1	16	0.12	0.13		
	Potted ornamentals	0.2 lb ai/day	--			15			350	1800	14	14		
FLAGGER														
Flagging Aerial Spray Applications (11)	tobacco	4	350	not applicable	0.01 double layers only; no gloves	not applicable	0.42 (no gloves)	0.07	6.4	32	not applicable	not applicable	0.39 (no gloves)	0.41 (no gloves)
	asparagus (SLN), barley	1	350				1.7 (no gloves)		26	130			1.6 (no gloves)	1.6 (no gloves)
	barley	1	1200				0.49 (no gloves)		7.5	38			0.46 (no gloves)	0.48 (no gloves)
	wheat	0.75	1200				0.65 (no gloves)		10	50			0.61 (no gloves)	0.64 (no gloves)
	sorghum	0.5	1200				0.97 (no gloves)		15	75			0.91 (no gloves)	0.96 (no gloves)
	potatoes (foliar)	0.5	350				3.3 (no gloves)		51	260			3.1 (no gloves)	3.3 (no gloves)
	cotton (SLN)	0.2	350				8.3 (no gloves)		130	640			7.8 (no gloves)	8.2 (no gloves)

Table 3: Occupational Handler Intermediate-Term Exposures and Risks with Personal Protective Equipment continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal (gloves) Unit Exposure[c] (mg/lb ai)	Dermal (gloves, double layers) Unit Exposure[c] (mg/lb ai)	Dermal (gloves) MOE[d]	Dermal (gloves, double layers) MOE[d]	Inhalation (respirator) Unit Exposure[e] (ug/lb ai)	Inhalation (baseline) MOE[f]	Inhalation (respirator) MOE[g]	Dermal (gloves) + Inhalation (baseline) MOE[h]	Dermal (gloves) + Inhalation (respirator) MOE[h]	Dermal (gloves, double layers) + Inhalation (baseline) MOE[h]	Dermal (gloves, double layers) + Inhalation (respirator) MOE[h]
Flagging Granular Applications (12)	tobacco	4	350	not applicable	0.0016 double layers only; no gloves	not applicable	2.6	0.03	15	75	not applicable	not applicable	2.2 (no gloves)	2.5 (no gloves)
	potatoes (soil)	3	350				3.5		20	100			3 (no gloves)	3.4 (no gloves)
	peas, lentils	2.5	350				4.2		24	120			3.6 (no gloves)	4 (no gloves)
	peanuts (SLN)	2	350				5.2		30	150			4.4 (no gloves)	5 (no gloves)
	clover grown for seed (SLN), barley, sorghum, wheat	1	350				10		60	300			8.9 (no gloves)	10 (no gloves)
	barley, sorghum, wheat	1	1200				3		18	88			2.6 (no gloves)	2.9 (no gloves)

Footnotes:

a Application rates are based on maximum values found on various labels or proposed by registrant. In most scenarios, a range of maximum application rates is used to represent the range of rates for different crops/sites/uses. Most application rates upon which the analysis is based are presented as lb ai/A. In the case of ornamentals in pots, the application rate is presented as lb ai/day). Specific application rates and the corresponding EPA Reg. numbers that are intended as examples of each exposure assessment scenario are presented in the table indicating risks at baseline attire.

b Amount handled per day values are based on HED Exposure SAC Policy # 009 "Standard Values for Daily Acres Treated in Agriculture," revised June 23, 2000, or best professional judgment when data is not available.

c Unless otherwise footnoted, personal protective equipment dermal unit exposure values are from PHED Surrogate Exposure Guide, draft version August, 1998. PPE dermal exposure assumes long pants, long sleeved shirt, plus gloves and/or double-layer body protection; open mixing/loading, open cab/tractor. (See *Exposure Scenarios Descriptions Table* for further information.)

d Intermediate-term dermal MOE = NOAEL (0.03 mg/kg/day / intermediate-term PPE daily dermal dose (mg/kg/day), where daily dermal dose = [unit dermal exposure (mg/lb ai) * application rate (lb ai/acre) * daily acres treated * dermal absorption (36%)]/ body weight (70 kg). [Note: application rate and acres treated/day are replaced by pounds handled per day for ornamentals in pots scenario.] Uncertainty Factor = 100.

e Unless otherwise footnoted, personal protective equipment inhalation unit exposure values are from PHED Surrogate Exposure Guide, draft version August, 1998 representing use of a dust mist respirator -- calculated using an 80% protection factor from baseline inhalation exposure values.

f Baseline inhalation MOE from table indicating risks at baseline attire (no respirator)

g PPE Inhalation MOE = NOAEL (0.045 mg/kg/day) / PPE inhalation dose, where daily PPE inhalation dose = (unit exposure (μg/lb ai) * (1mg/1000 μg) conversion * appl. rate (lb ai/A) * acres treated/day)/body weight (70 kg) [Note: application rate and acres treated/day are replaced by pounds handled per day for ornamentals in pots scenario.] Uncertainty Factor = 100.

h Total PPE Intermediate-term MOE =

$$\frac{1}{\frac{1}{\text{dermal MOE}} + \frac{1}{\text{inhalation MOE}}}$$

i Unit exposure values from Outdoor Residential Exposure Task Force study: ORETF Study Number OMA001. "*Exposure of Professional Lawn Care Workers During the Mixing, Loading and Application of Granular Turf Pesticides Utilizing a Surrogate Compound*". Values from EPA memo dated April 30, 2001 using same standard PPE assumptions as for PHED (footnotes c and e). Geometric mean is used for dermal values and median is used for inhalation value.

j Unit exposure values from a loader/applicator study using passive dosimetry and pump-feed backpack equipment to load and apply aldicarb granules to the soil at the base of banana trees. MRID # 451672-01 *Worker Exposure Study During Application in Banana Plantation with Temik 10G*. Applicators wore baseline attire plus Tyvek gloves and a back apron. Geometric mean is used for dermal and inhalation values.

k Unit exposure values from a loader/applicator study using passive dosimetry and gravity-feed backpack equipment to load and apply fipronil granules to the soil at the base of banana trees. MRID # 452507-02 *Worker Exposure Study During Application of Regent 10GR in Banana Plantation*. Applicators wore baseline attire plus PVC gloves. Geometric mean is used for dermal and inhalation values.
Unit exposure values from a loader/applicator study using passive dosimetry and handheld bucket and scoop equipment to load and apply fipronil granules to the soil at the base of banana trees. MRID # 452507-02 *Worker Exposure Study During Application of Regent 10GR in Banana Plantation*. Applicators wore baseline attire plus PVC gloves. Geometric mean is used for dermal and inhalation values.

Table 4: Occupational Handler Short- and Intermediate-Term Exposures and Risks with Engineering Controls

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal Engineering Control Unit Exposure[c] (mg/lb ai)	Inhalation Engineering Control Unit Exposure[d] (ug/lb ai)	Short-Term Dermal Engineering Control MOE[e]	Intermediate-Term Dermal Engineering Control MOE[f]	Baseline Inhalation (no respirator) MOE[g]	Inhalation Engineering Control MOE [h]	Combined Short-Term Eng. Control Dermal + Eng. Control Inhalation MOE[i]	Combined Interm-Term Eng. Control Dermal + Eng Control Inhalation MOE[i]	Combined Short-Term Eng. Control Dermal + Baseline Inhalation MOE[i]	Combined Interm-Term Eng. Control Dermal + Baseline Inhalation MOE[i]
MIXER/LOADER													
Mixing/Loading Liquid Formulations for Aerial Application (1a)	tobacco	4	350	0.0086	0.083	2.9	0.48	1.9	27	2.6	0.48	1.1	0.39
	asparagus (SLN)	1	350			12	1.9	7.5	110	11	1.9	4.6	1.5
	barley	1	1200			3.4	0.57	2.2	32	3.1	0.56	1.3	0.45
	wheat	0.75	1200			4.5	0.75	2.9	42	4.1	0.74	1.8	0.6
	sorghum	0.5	1200			6.8	1.1	4.4	63	6.1	1.1	2.7	0.9
	potatoes (foliar)	0.5	350			23	3.9	15	220	21	3.8	9.1	3.1
	cotton (SLN)	0.2	1200			17	2.8	11	160	15	2.8	6.6	2.2
Mixing/Loading Liquid Formulations for Chemigation Application (1b)	potatoes (foliar) - OR, WA, ID, UT	3	350			3.9	0.65	2.5	36	3.5	0.63	1.5	0.51
	poplars grown for pulpwood (SLN)	3	350			3.9	0.65	2.5	36	3.5	0.63	1.5	0.51
	cabbage, lettuce	2	350			5.8	0.97	3.8	54	5.3	0.95	2.3	0.77
	broccoli, brussels sprouts, cauliflower, cotton	1	350			12	1.9	7.5	110	11	1.9	4.6	1.5
Mixing/Loading Liquid Formulations for Groundboom Application (1c)	tobacco	4	80			13	2.1	8.2	120	11	2.1	5	1.7
	poplars grown for pulpwood (SLN)	3	80			17	2.8	11	160	15	2.8	6.6	2.2
	potatoes (soil)	3	80			17	2.8	11	160	15	2.8	6.6	2.2
	peas, lentils	2.5	80			20	3.4	13	190	18	3.3	8	2.7
	beans (dry, snap, lima), lettuce, peppers, radish grown for seed, cabbage	2	80			25	4.2	16	240	23	4.2	10	3.4
	wheat, barley, cotton, sorghum	1	200			20	3.4	13	190	18	3.3	8	2.7
	asparagus (SLN), broccoli, brussels sprouts, cauliflower	1	80			51	8.5	33	470	46	8.3	20	6.7
	potatoes (foliar)	0.5	80			100	17	66	950	92	17	40	13

Table 4: Occupational Handler Short- and Intermediate-Term Exposures and Risks with Engineering Controls continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal Engineering Control Unit Exposure[c] (mg/lb ai)	Inhalation Engineering Control Unit Exposure[d] (ug/lb ai)	Short-Term Dermal Engineering Control MOE[e]	Intermediate-Term Dermal Engineering Control MOE[f]	Baseline Inhalation (no respirator) MOE[g]	Inhalation Engineering Control MOE [h]	Combined Short-Term Eng. Control Dermal + Eng. Control Inhalation MOE[i]	Combined Interm-Term Eng. Control Dermal + Eng Control Inhalation MOE[i]	Combined Short-Term Eng. Control Dermal + Baseline Inhalation MOE[i]	Combined Interm-Term Eng. Control Dermal + Baseline Inhalation MOE[i]
Loading Granular Formulations for Aerial Application (2a)	tobacco	4	350	0.00017	0.034	150	25	1.3	66	46	18	NF	NF
	potatoes (soil)	3	350			200	33	1.8	88	61	24	NF	NF
	peas, lentils	2.5	350			240	39	2.1	110	73	29	NF	NF
	peanuts (SLN)	2	350			290	49	2.6	130	91	36	NF	NF
	clover grown for seed (SLN)	1	350			590	98	5.3	260	180	72	NF	NF
	barley, sorghum, wheat	1	1200			170	29	1.5	77	53	21	NF	NF
Loading Granular Formulations for Ground Application (2b)	field-grown ornamental shrubs	109	40			47	7.9	0.42	21	15	5.7	NF	NF
	field-grown ornamental trees	37	40			140	23	1.3	63	43	17	NF	NF
	field-grown flowers & groundcover	29	40			180	30	1.6	80	55	22	NF	NF
	field-grown ornamental trees and shrubs (inject)	11	40			470	78	4.2	210	150	57	NF	NF
	coffee trees	8.3	80			310	52	2.8	140	96	38	NF	NF
	Christmas trees	78	50			53	8.8	0.48	24	16	6.4	NF	NF
	Christmas trees (SLN)	4.5	50			920	150	8.2	410	280	110	NF	NF
	tobacco	4	80			640	110	5.8	290	200	78	NF	NF
	potatoes (soil)	3	80			860	140	7.7	390	270	100	NF	NF
	peas, lentils	2.5	80			1000	170	9.3	460	320	130	NF	NF
	peppers, peanuts (SLN), radish grown for seed (SLN)	2	80			1300	210	12	580	400	160	NF	NF
	cabbage	1.5	80			1700	290	15	770	530	210	NF	NF
	barley, cotton, sorghum, soybeans, wheat	1	200			1000	170	9.3	460	320	130	NF	NF

Table 4: Occupational Handler Short- and Intermediate-Term Exposures and Risks with Engineering Controls continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal Engineering Control Unit Exposure[c] (mg/lb ai)	Inhalation Engineering Control Unit Exposure[d] (ug/lb ai)	Short-Term Dermal Engineering Control MOE[e]	Intermediate-Term Dermal Engineering Control MOE[f]	Baseline Inhalation (no respirator) MOE[g]	Inhalation Engineering Control MOE [h]	Combined Short-Term Eng. Control Dermal + Eng. Control Inhalation MOE[i]	Combined Interm-Term Eng. Control Dermal + Eng Control Inhalation MOE[i]	Combined Short-Term Eng. Control Dermal + Baseline Inhalation MOE[i]	Combined Interm-Term Eng. Control Dermal + Baseline Inhalation MOE[i]
	peanuts, beans (dry, snap, lima), brussels sprout, cauliflower, broccoli, clover grown for seed (SLN)	1	80			2600	430	23	1200	800	310	NF	NF
APPLICATOR													
Applying Sprays with an Airplane (3)	tobacco	4	350	0.005	0.068	5	0.83	No Data	33	4.3	0.81	No Data	No Data
	asparagus (SLN)	1	350			20	3.3		130	17	3.3	No Data	No Data
	barley	1	1200			5.8	0.97		39	5.1	0.95	No Data	No Data
	wheat	0.75	1200			7.8	1.3		51	6.8	1.3	No Data	No Data
	sorghum	0.5	1200			12	1.9		77	10	1.9	No Data	No Data
	potatoes (foliar)	0.5	350			40	6.7		260	35	6.5	No Data	No Data
	cotton (SLN)	0.2	1200			29	4.9		190	25	4.7	No Data	No Data
Applying Granulars with an Airplane (4)	tobacco	4	350	0.0017	1.3	15	2.5	No Data	1.7	1.5	1	No Data	No Data
	potatoes (soil)	3	350			20	3.3		2.3	2.1	1.4	No Data	No Data
	peas, lentils	2.5	350			24	3.9		2.8	2.5	1.6	No Data	No Data
	peanuts (SLN)	2	350			29	4.9		3.5	3.1	2	No Data	No Data
	barley, sorghum, wheat	1	1200			17	2.9		2	1.8	1.2	No Data	No Data
	clover grown for seed (SLN)	1	350			59	9.8		6.9	6.2	4.1	No Data	No Data
Applying with a Groundboom (5)	tobacco	4	80	0.005	0.043	22	3.6	13	230	20	3.6	8.3	2.9
	poplars grown for pulpwood (SLN)	3	80			29	4.9	18	310	27	4.8	11	3.8
	potatoes (soil)	3	80			29	4.9	18	310	27	4.8	11	3.8
	peas, lentils	2.5	80			35	5.8	21	370	32	5.7	13	4.6
	beans(dry, snap, lima), lettuce,> peppers, radish grown for seed, cabbage	2	80			44	7.3	27	460	40	7.2	17	5.7
	wheat, barley, cotton, sorghum	1	200			35	5.8	21	370	32	5.7	13	4.6

Table 4: Occupational Handler Short- and Intermediate-Term Exposures and Risks with Engineering Controls continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal Engineering Control Unit Exposure[c] (mg/lb ai)	Inhalation Engineering Control Unit Exposure[d] (ug/lb ai)	Short-Term Dermal Engineering Control MOE[e]	Intermediate-Term Dermal Engineering Control MOE[f]	Baseline Inhalation (no respirator) MOE[g]	Inhalation Engineering Control MOE [h]	Combined Short-Term Eng. Control Dermal + Eng. Control Inhalation MOE[i]	Combined Interm-Term Eng. Control Dermal + Eng Control Inhalation MOE[i]	Combined Short-Term Eng. Control Dermal + Baseline Inhalation MOE[i]	Combined Interm-Term Eng. Control Dermal + Baseline Inhalation MOE[i]
	asparagus (SLN), broccoli, brussels sprouts, cauliflower	1	80			88	15	53	920	80	14	33	11
	potatoes (foliar)	0.5	80			180	29	110	1800	160	29	66	23
Applying Granulars with a Tractor Drawn Spreader (6)	field-grown ornamental shrubs	109	40	0.0021	0.22	3.8	0.64	0.6	3.3	1.8	0.53	0.52	0.31
	field-grown ornamental trees	37	40			11	1.9	1.8	9.7	5.2	1.6	1.5	0.91
	field-grown flowers & groundcover	29	40			14	2.4	2.3	12	6.6	2	2	1.2
	field-grown ornamental trees & shrubs (inject) and flowers & groundcover	11	40			38	6.3	6	33	18	5.3	5.2	3.1
	coffee trees	8.3	80			25	4.2	4	22	12	3.5	3.4	2
	Christmas trees	78	50			4.3	0.71	0.67	3.7	2	0.6	0.58	0.35
	Christmas trees (SLN)	4.5	50			74	12	12	64	34	10	10	6
	tobacco	4	80			52	8.7	8.2	45	24	7.3	7.1	4.2
	potatoes (soil)	3	80			69	12	11	60	32	9.7	9.4	5.6
	peas, lentils	2.5	80			83	14	13	72	39	12	11	6.7
	peppers, peanuts (SLN), radish grown for seed (SLN)	2	80			100	17	16	89	48	15	14	8.4
	cabbage	1.5	80			140	23	22	120	64	19	19	11
	barley, cotton, sorghum, soybeans, wheat	1	200			83	14	13	72	39	12	11	6.7
	peanuts, beans (dry, snap, lima), brussels sprout, cauliflower, broccoli, clover grown for seed-SLN	1	80			210	35	33	180	96	29	28	17
MIXER/LOADER/APPLICATOR													

Table 4: Occupational Handler Short- and Intermediate-Term Exposures and Risks with Engineering Controls continued

Exposure Scenario	Crop Type	Application Rate[a]	Acres Treated[b]	Dermal Engineering Control Unit Exposure[c] (mg/lb ai)	Inhalation Engineering Control Unit Exposure[d] (ug/lb ai)	Short-Term Dermal Engineering Control MOE[e]	Intermediate-Term Dermal Engineering Control MOE[f]	Baseline Inhalation (no respirator) MOE[g]	Inhalation Engineering Control MOE [h]	Combined Short-Term Eng. Control Dermal + Eng. Control Inhalation MOE[i]	Combined Interm-Term Eng. Control Dermal + Eng Control Inhalation MOE[i]	Combined Short-Term Eng. Control Dermal + Baseline Inhalation MOE[i]	Combined Interm-Term Eng. Control Dermal + Baseline Inhalation MOE[i]
Loading/Applying with a Push Type Spreader (ORETF) (7)	Not Feasible												
Loading/Applying with a Bellygrinder (PHED) (8)	Not Feasible												
Loading/Applying Granulars with a Pump-Feed Backpack Spreader (Aldicarb) (9a)	Not Feasible												
Loading/Applying Granular with a Gravity-Feed Backpack Spreader (Fipronil) (9b)	Not Feasible												
Scoop and Bucket (Fipronil) (10)	Not Feasible												
FLAGGER													
Flagging Aerial Spray Applications (11)	tobacco	4	350	0.00022	0.007	110	19	6.4	320	84	18	6.1	4.8
	asparagus (SLN), barley	1	350	0.00022		450	76	26	1300	340	72	24	19
	barley	1	1200	0.00022		130	22	7.5	380	98	21	7.1	5.6
	wheat	0.75	1200	0.00022		180	29	10	500	130	28	9.5	7.5
	sorghum	0.5	1200	0.00022		270	44	15	750	200	42	14	11
	potatoes (foliar)	0.5	350	0.00022		910	150	51	2600	670	140	49	38
	cotton (SLN)	0.2	350	0.00022		2300	380	130	6400	1700	360	120	96
Flagging Granular Applications (12)	tobacco	4	350	0.000056	0.003	450	74	15	750	280	68	15	12
	potatoes (soil)	3	350	0.000056		600	99	20	1000	370	90	19	17
	peas, lentils	2.5	350	0.000056		710	120	24	1200	450	110	23	20
	peanuts (SLN)	2	350	0.000056		890	150	30	1500	560	140	29	25
	clover grown for seed (SLN), barley, sorghum, wheat	1	350	0.000056		1800	300	60	3000	1100	270	58	50
	barley, sorghum, wheat	1	1200	0.000056		520	87	18	880	330	79	17	15

Footnotes:

a Application rates are based on maximum values found on various labels or proposed by registrant. In most scenarios, a range of maximum application rates is used to represent the range of rates for different crops/sites/uses. Most application rates upon which the analysis is based are presented as lb ai/A. In the case of ornamentals in pots, the application rate is presented as lb ai/day). Specific application rates and the corresponding EPA Reg. numbers that are intended as examples of each exposure assessment scenario are presented in the table indicating risks at baseline attire.

Table 4: Occupational Handler Short- and Intermediate-Term Exposures and Risks with Engineering Controls continued

b Amount handled per day values are based on HED Exposure SAC Policy # 009 "Standard Values for Daily Acres Treated in Agriculture," revised June 23, 2000, or best professional judgment when data is not available.

c Unless otherwise footnoted, engineering control dermal unit exposure values are from PHED Surrogate Exposure Guide, draft version August, 1998. Engineering control dermal exposure assumes long pants, long sleeved shirt plus closed system mixing/loading, and enclosed tractor cab/cockpit. Mixers and loaders wear gloves. (See *Exposure Scenarios Descriptions Table* for further information.)

d Unless otherwise footnoted, engineering control inhalation unit exposure values are from PHED Surrogate Exposure Guide, draft version August, 1998. Engineering control inhalation exposure assumes no respirator plus closed system mixing/loading, and enclosed tractor cab/cockpit. (See *Exposure Scenarios Descriptions Table* for further information.)

e Short-term dermal MOE = NOAEL (0.5 mg/kg/day / short-term engineering control daily dermal dose (mg/kg/day), where daily dermal dose = [unit dermal exposure (mg/lb ai) * application rate (lb ai/acre) * daily acres treated * dermal absorption (100%)]/ body weight (70 kg). Uncertainty Factor = 100.

f Intermediate-term dermal MOE = NOAEL (0.03 mg/kg/day / intermediate-term engineering control daily dermal dose (mg/kg/day), where daily dermal dose = [unit dermal exposure (mg/lb ai) * application rate (lb ai/acre) * daily acres treated * dermal absorption (36%)]/ body weight (70 kg). Uncertainty Factor = 100.

g Baseline inhalation MOE from table indicating risks at baseline attire (no respirator)

h Engineering Control Inhalation MOE = NOAEL (0.045 mg/kg/day) / Engineering control inhalation dose, where daily engineering control inhalation dose = (unit exposure (μg/lb ai) * (1mg/1000 μg) conversion * appl. rate (lb ai/A) * acres treated/day)/body weight (70 kg). Uncertainty Factor = 100.

i Total Engineering Control Short- and Intermediate-term MOE =

$$\frac{1}{\frac{1}{\text{dermal MOE}} + \frac{1}{\text{inhalation MOE}}}$$

Table 5: Exposure Scenario Descriptions for the Occupational Use of Disulfoton continued

Table 5: Exposure Scenario Descriptions for the Occupational Use of Disulfoton

Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
MIXER/LOADER DESCRIPTORS			
Mixing/Loading Liquid Formulations (Emulsifiable Concentrates) (1a, 1b, and 1c)	PHED V1.1	1200 and 350 acres for aerial; 350 acres for chemigation; 200 and 80 acres for groundboom application;	**Baseline:** Dermal (72 to 122 replicates); hand (53 replicates); and inhalation (85 replicates) exposure values are all based on AB grade data. High confidence in the unit exposure value. No protection factors were needed to define the unit exposure value. **PPE:** The same dermal and inhalation data are used as for the baseline coupled with a 50% protection factor to account for an additional layer of clothing and a 5-fold protection factor to account for the use of a dust/mist respirator. Hand (59 replicates) exposure value is based on AB grade data. High confidence in the unit dermal exposure value. **Engineering Controls:** Dermal (31 replicates) exposure value is based on AB grade data. Hand (31 replicates) and inhalation (27 replicates) exposure values are based on AB grade data. High confidence in the dermal unit exposure value. Low confidence in inhalation unit exposure value. Empirical data include the use of chemical-resistant gloves. No protection factors were needed to define the unit exposure value.
Loading Granular Formulations (2a and 2b)	PHED V1.1	1200 and 350 acres for aerial application, 200 and 80 acres for tractor drawn spreader agricultural application, and 2 acres for ornamental flowers/groundcover, and trees	**Baseline:** Hands = All grade, dermal = ABC grade, and inhalation = AB grade. Hands = 10 replicates; dermal = 33 to 78 replicates; and inhalation = 58 replicates. Low confidence in dermal/ hand data. High confidence in inhalation data. **PPE**: Hands = AB grade, dermal = ABC grade. Dermal = 45 replicates, hands = 12-59 replicates. Low confidence in dermal and hands data. A 5-fold PF was applied to the baseline inhalation data to account for the use of a dust mist respirator. **Engineering Controls:** Closed loading of granulars. 98% PF was applied to baseline data.
APPLICATOR DESCRIPTORS			
Applying Liquid Formulations (Emulsifiable Concentrates) with an Aircraft (3)	PHED V1.1	1200 and 350 acres for aerial	**Baseline:** No data **PPE:** No data **Engineering Controls:** Hands = AB grade, dermal and inhalation = ABC grade. Medium confidence in hands/dermal and inhalation data. Hands = 34 replicates, dermal = 24-48 replicates, and inhalation = 23 replicates.

Table 5: Exposure Scenario Descriptions for the Occupational Use of Disulfoton continued

Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Applying Granulars with an Aircraft (4)	PHED V1.1	1200 and 350 acres for aerial	**Baseline:** No data **PPE:** No data **Engineering Controls:** Hands and inhalation - All grade, dermal - C grade. Hands = 4 replicates, inhalation = 13 replicates, and dermal = 0-13 replicates. Low confidence in all data.
Applying Sprays with a Groundboom (5)	PHED V1.1	200 and 80 acres in agricultural applications	**Baseline:** Hand, dermal, and inhalation = AB grades. Hands = 29 replicates, dermal = 23 to 42 replicates, and inhalation = 22 replicates. High confidence in hand, dermal, and inhalation data. **PPE:** The same dermal and inhalation data are used as for the baseline coupled with a 50% protection factor to account for an additional layer of clothing, and an 80% PF to account for the use of a dust mist respirator, respectively. Hands data are ABC grades with 21 replicates. Medium confidence in hands, and dermal data. **Engineering Controls:** Hands and dermal = ABC grade, inhalation = AB grade. Hands = 16 replicates, dermal = 20-31 replicates, inhalation = 16 replicates. Medium confidence in hands and dermal data, and high confidence in inhalation data.
Applying Granulars with a Tractor-Drawn Spreader (6)	PHED V1.1	1200 and 80 acres for agricultural crops, 50 acres for Christmas trees; and 40 acres for ornamentals	**Baseline:** Hands, dermal and inhalation = AB grades. Low confidence in hands, dermal and inhalation data. Hands = 5 replicates, dermal = 1-5 replicates and inhalation = 5 replicates. **PPE:** The same hand and dermal data are used as for the baseline coupled with a 90% PF to account for chemical resistant gloves, and a 50% PF to account for an additional layer of clothing, respectively. The same inhalation data are used as for the baseline coupled with an 80% PF to account for the use of a dust mist respirator. **Engineering Controls:** Hands, dermal and inhalation data are AB grades. Hands = 24 replicates, dermal = 27 to 30 replicates, and inhalation = 2-30 replicates. High confidence in hands, dermal and inhalation data.
MIXER/LOADER/APPLICATOR DESCRIPTORS			

Table 5: Exposure Scenario Descriptions for the Occupational Use of Disulfoton continued

Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Loading and Applying Granulars with a Push Type Spreader (7)	ORETF Study OMA001	5 acres	**Baseline**: Hand (20 replicates), dermal (40 replicates) and inhalation (40 replicates) data were used to establish unit exposure values. **PPE**: The same dermal and inhalation data are used as for the baseline coupled, when needed, with a 50% protection factor to account for an additional layer of clothing and a 80% protection factor to account for the use of a dust/mist respirator. Gloved-hand (20 replicates) data used to establish exposure value. **Engineering Controls**: Not available for this scenario.
Loading/Applying Granulars Using a Belly Grinder (8)	PHED V1.1	1acre	**Baseline:** Hands and dermal = ABC grades and inhalation = AB grade. Medium confidence in hands/dermal data and high confidence in inhalation data. Hands = 23 replicates, dermal = 29-45 replicates and inhalation = 40 replicates. **PPE:** = Gloved data for hands = ABC grade with 15 replicates. The dermal data are taken from the baseline coupled with a 50% protection factor to account for an additional layer of clothing. A 5-fold protection factor (80% PF) was applied to baseline inhalation data to account for use of dust mist respirator. **Engineering Controls:** Not feasible
Loading/Applying Granulars with a Pump-Feed Backpack Spreader (9a)	Proprietary (aldicarb study: MRID # 451672-01	5 and 10 acres; 350 pots	**Baseline:** No data **PPE:** Hand (with gloves), dermal, and inhalation = 12 replicates. Grade B data (based on PHED grading criteria). A 5-fold protection factor (80% PF) was applied to baseline inhalation data to account for use of dust mist respirator. **Engineering Controls:** Not applicable.
Loading/Applying Granulars with a Gravity-Feed Backpack Spreader (9b)	Proprietary (fipronil study: MRID # 452507-01	5 and 10 acres; 350 pots	**Baseline:** No data **PPE:** Hand (with gloves), dermal, and inhalation = 8 replicates. Grade A data (based on PHED grading criteria). A 5-fold protection factor (80% PF) was applied to baseline inhalation data to account for use of dust mist respirator. **Engineering Controls:** Not applicable.

Table 5: Exposure Scenario Descriptions for the Occupational Use of Disulfoton continued

Exposure Scenario (Number)	Data Source	Standard Assumptions[a] (8-hr work day)	Comments[b]
Loading/Applying Granulars with a Scoop and Bucket (10)	Proprietary (fipronil study: MRID # 452507-01	5 and 10 acres; 350 pots	**Baseline:** No data **PPE:** Hand (with gloves), dermal, and inhalation = 10 replicates. Grade A data (based on PHED grading criteria). A 5-fold protection factor (80% PF) was applied to baseline inhalation data to account for use of dust mist respirator. **Engineering Controls:** Not applicable.
FLAGGER DESCRIPTORS			
Flagging Aerial Spray Applications (11)	PHED V1.1	350 acres	**Baseline:** Hands, dermal and inhalation data = AB grades. High confidence in dermal, hands and inhalation. Hands = 30 replicates, Inhalation = 28 replicates, and dermal = 18-28 replicates. **PPE:** Dermal and hands = AB grade. Hands = 6 replicates, dermal = 18-28 replicates. Low confidence for dermal and hands data. A 50% PF was applied to baseline data to represent dust mist masks. **Engineering Controls:** Hands and dermal = ABC grade, inhalation = AB grade. Inhalation = 16 replicates, dermal = 16 replicates, and dermal = 20-31 replicates. Medium confidence in hands, dermal data, and high confidence in inhalation data. These data are based on groundboom enclosed cab data.
Flagging Aerial Granular Applications (12)	PHED V1.1	350 acres	**Baseline:** Hands and dermal = ABC grades. Dermal = 16-20 replicates, and hands = 4 replicates. Dermal values based on total deposition data assuming 50% PF applied to no clothes values. Inhalation = E grade with 4 replicates. Low confidence in all values. **PPE:** Dermal value based on 50% PF over baseline to account for double layer of clothes. Hands values based on 90% PF over baseline to account for use of gloves, and inhalation values based on 50% PF over baseline to account for use of dust mist mask. **Engineering Controls:** Hands, dermal and inhalation = AB grades with high confidence. Hands = 24 replicates, dermal = 27 to 30 replicates and inhalation = 37 replicates. All data based on granular drop type tractor drawn spreader enclosed cab.

Footnotes:

a All *Standard Assumptions* are based on an 8-hour work day as estimated by HED.

b All handler exposure assessments in this document are based on the "Best Available" data as defined by the PHED SOP for meeting Subdivision U Guidelines (i.e., completing exposure assessments). Best available grades are assigned to data as follows: matrices with A and B grade data (i.e., Acceptable Grade Data) and a minimum of 15 replicates; if

Table 5: Exposure Scenario Descriptions for the Occupational Use of Disulfoton continued

not available, then grades A, B and C data and a minimum of 15 replicates; if not available, then all data regardless of the quality (i.e., All Grade Data) and number of replicates. High quality data with a protection factor take precedence over low quality data with no protection factor. Generic data confidence categories are assigned as follows:

High = grades A and B and 15 or more replicates per body part
Medium = grades A, B, and C and 15 or more replicates per body part
Low = any run that included D or E grade data or has less than 15 replicates per body part.